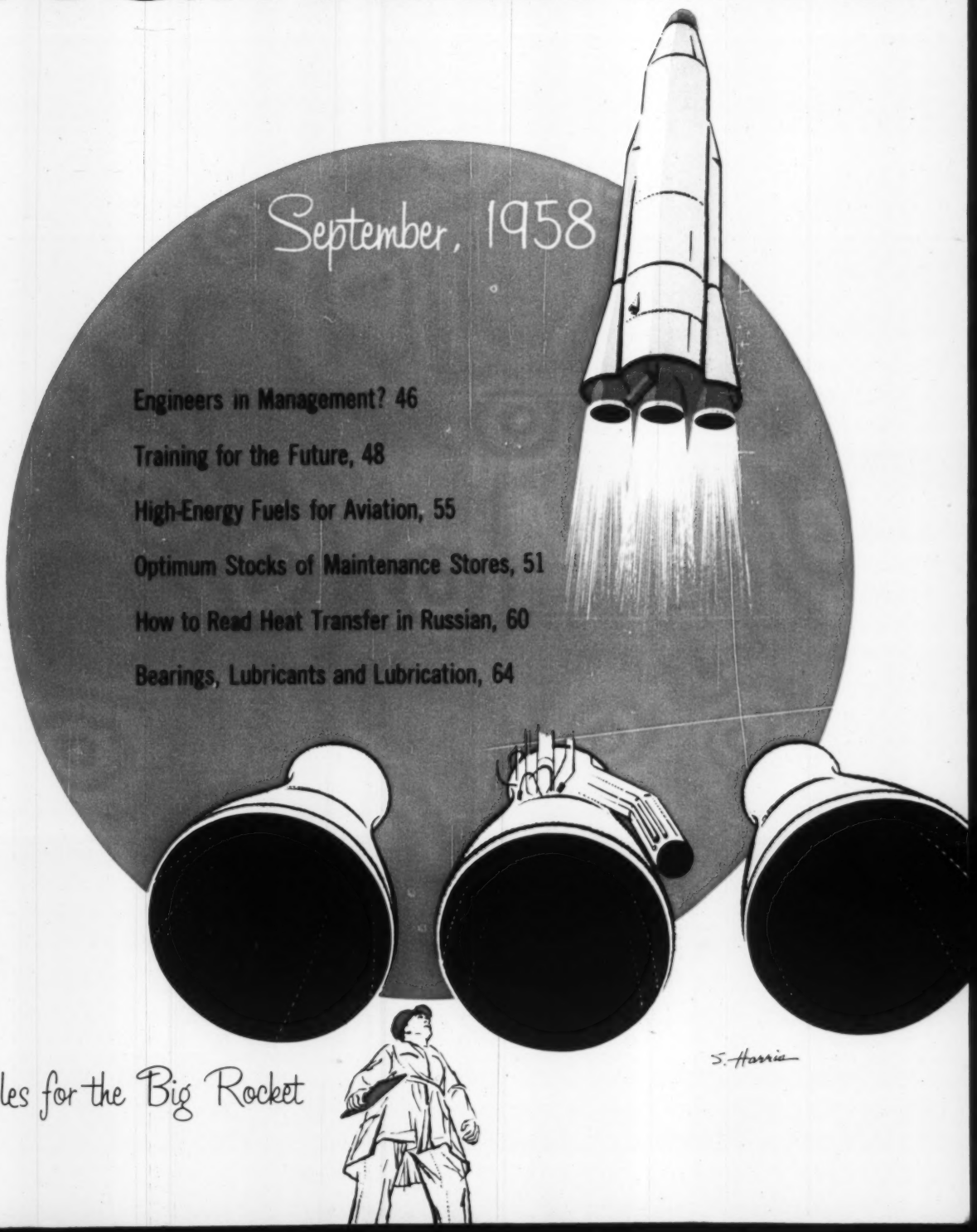
MECHANICAL ENGINEERING



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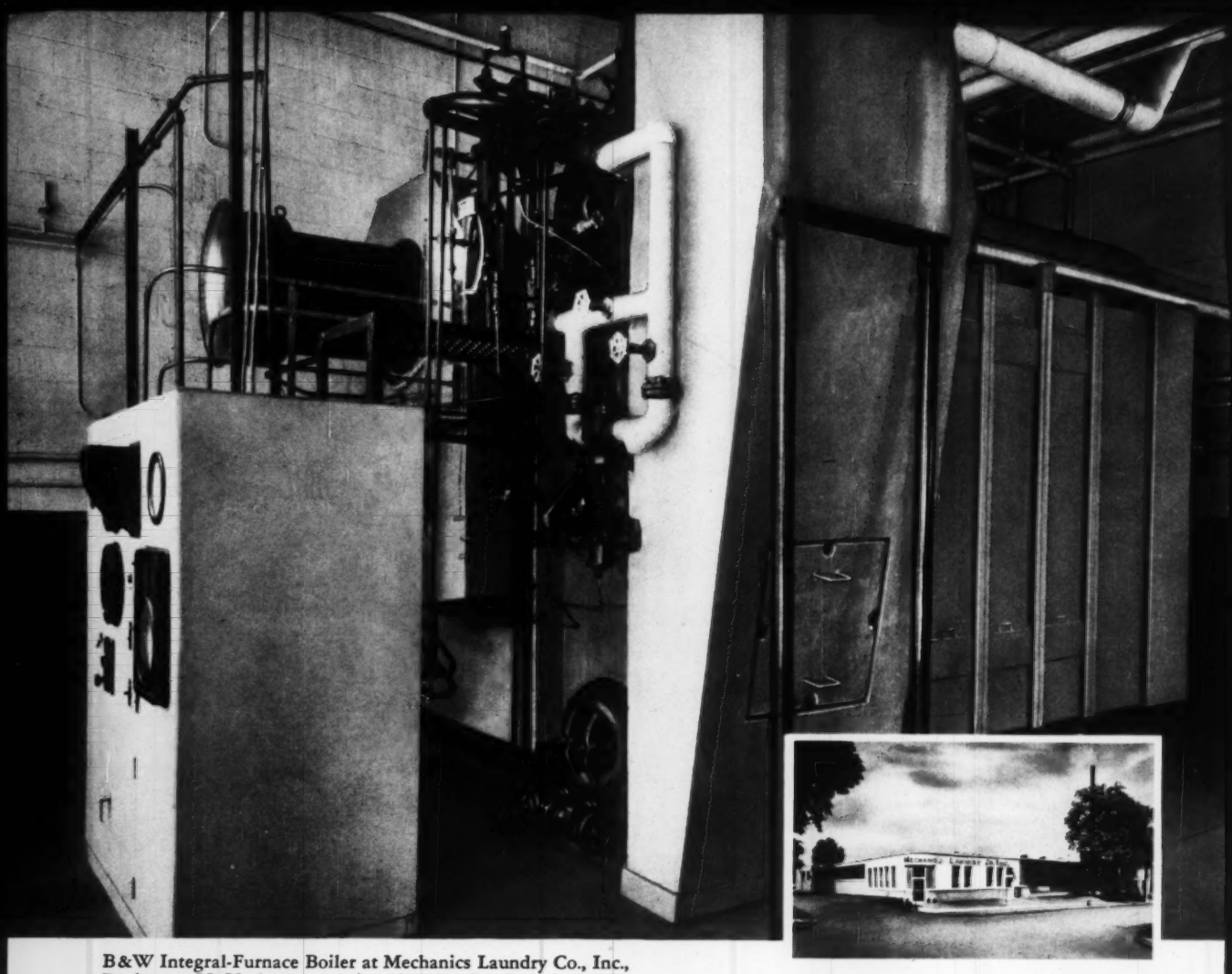
S. Harris

Nozzles for the Big Rocket



B&W Integral-Furnace Boiler at Mechanics Laundry Co., Inc., Rochester, N. Y., has a capacity of 20,500 lb of steam per hr at operating pressure of 125 psi and design pressure of 250 psi.

B&W INTEGRAL FURNACE BOILER SAVES LAUNDRY $4,000 A YEAR

Cuts Maintenance 90%, Fuel 15% While Meeting Wide Load Swings

Mechanics Laundry Co., Inc., of Rochester, N. Y., is saving an estimated $4,000 a year with its new B&W Integral-Furnace Boiler. The oil-burning unit replaced two old units and has given more steam at higher efficiency in one-half the former space.

Fluctuating Load demand of the industrial laundry ranges from 8,000 to 20,000 lb of steam per hr, several times a day. The B&W unit has met these wide load swings promptly and easily.

Fuel Savings alone amount to $200 a month. Maintenance has been reduced to practically nothing. The unit's response to load swings, its compact design, and operating efficiency are notable.

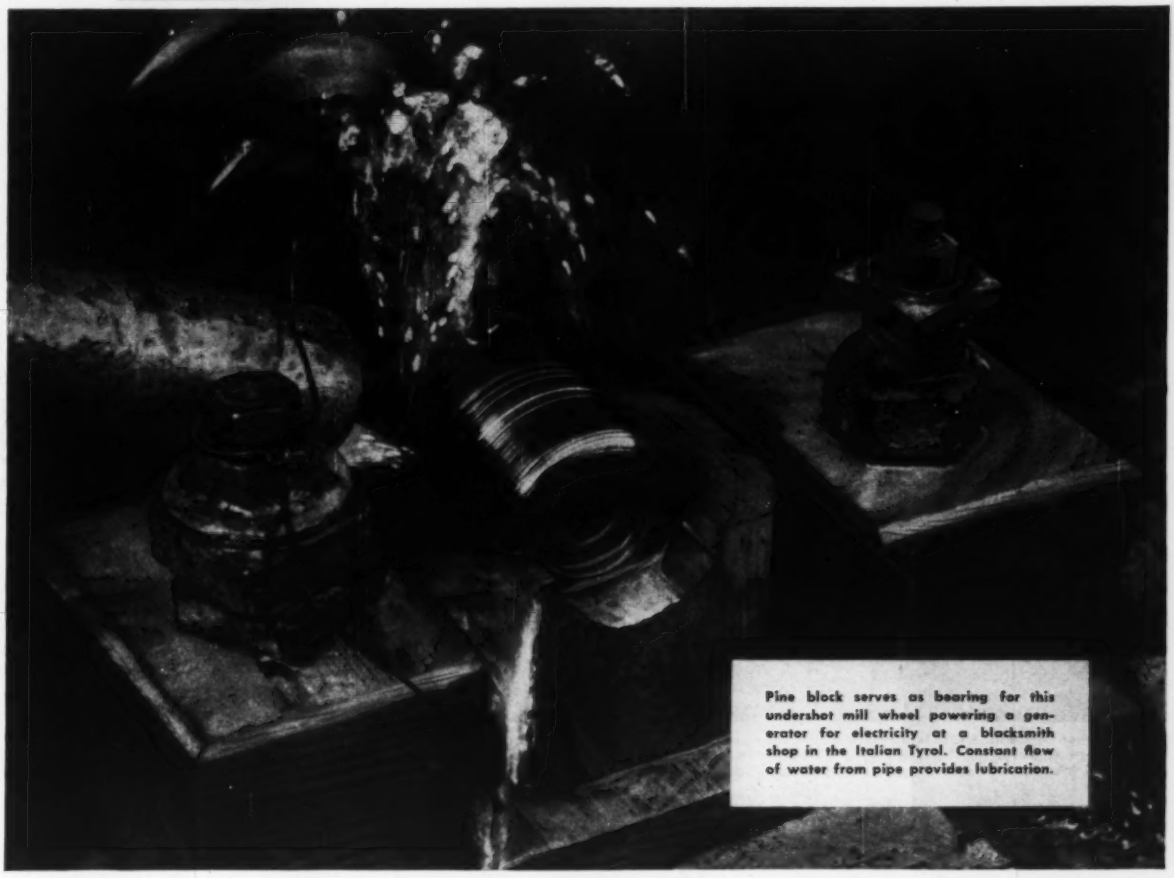
Continuity of Service and overall economy have been proved for B&W Integral-Furnace Boilers in hundreds of installations. They provide maximum capacity in small boiler room space, high availability, and smokeless combustion. Supported by a national network of plants and engineers, they are designed and engineered from a background of nearly a century of steam generating experience. The Babcock & Wilcox Company, Boiler Division, 161 East 42nd Street, New York 17, N. Y.

G-862-1B

BABCOCK & WILCOX

BOILER DIVISION

ND FACTS



Pine block serves as bearing for this undershot mill wheel powering a generator for electricity at a blacksmith shop in the Italian Tyrol. Constant flow of water from pipe provides lubrication.

Is pillow block inefficiency costing your plant money?

The need for relubrication of pillow blocks is *more* than costly today! It's *passé*. For New Departure's new pillow block line is built around the performance-proved Type AE adapter ball bearing with *Sentri-Seals*. Dirt, moisture and wear are sealed *out* . . . grease is sealed *in — for life!* Send for details about New Departure pillow blocks. Ask today for Catalog PBC-A.

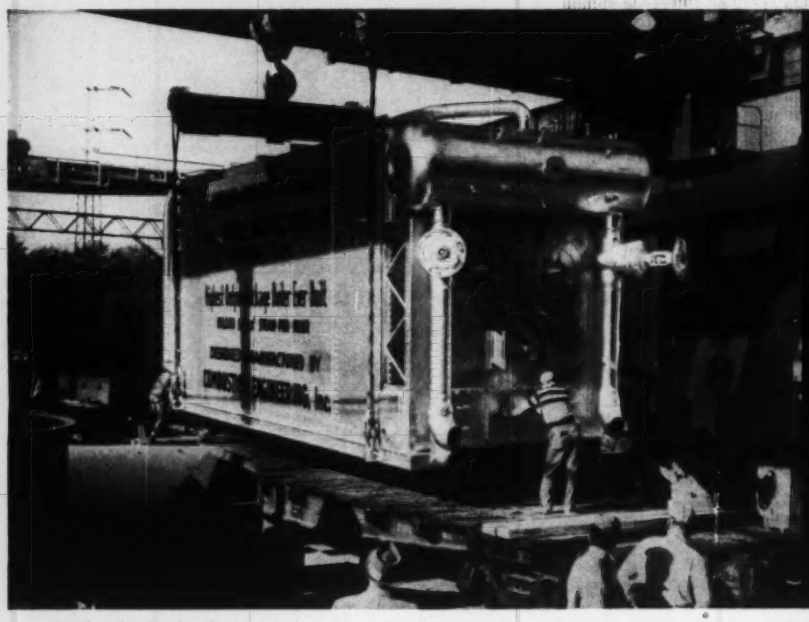
These bearings are quickly and easily applied to shafting without special tools. They are positively locked in position with eccentric cam locking collar and set screw.

1908–1958
GM
FORWARD FROM FIFTY

ND NEW DEPARTURE
DIVISION OF GENERAL MOTORS, BRISTOL, CONN.
NOTHING ROLLS LIKE A BALL

Announcing

THE C-E CONTROLLED CIRCULATION PACKAGE BOILER...Type PCC



A NEW HIGH PERFORMANCE DESIGN OFFERING

• Capacities to to 100,000 lb per hr

• Pressures to 1,000 psi

• Temperatures to 900 F.

Another Combustion first in the boiler field — the type PCC package unit, utilizing controlled circulation. This one, being loaded at our St. Louis shops for delivery to Scovill Manufacturing Co., is the world's highest output package boiler, having a design capacity of 100,000 lb of steam per hr. This picture illustrates the ease with which this new, high performance design can be readied for shipment. Its size permits transfer from railway siding to destination by truck.

Available for the first time to industrial steam users is C-E's famous controlled circulation design in a convenient package size. The oil- or gas-fired PCC offers capacities from 80,000 to 100,000 lb per hr, pressures from 450 to 1000 psi, and temperatures to 900 F. Higher pressures and temperatures are obtainable if desired.

Seven PCC boilers are now in service. One of these is a special-purpose design for steam conditions of 1500 psi and 1050 F.

The PCC is especially suitable where space is limited, yet high capacity, temperature, and pressure are required. It is only through the use of controlled circulation that such a compact, high-performance unit could be built. This exclusive C-E design assures positive distribution and control of water to all circuits, permitting the PCC to be placed on the line faster than any natural circulation boiler. It also allows easy handling of rapid load swings with high quality steam production.

Not only does the PCC combine outstanding performance in a unit requiring less space per pound of steam, but also it offers the inherent advantages of package boiler design: quality shop assembly by experts, quicker delivery, much less plant disruption for installation and, of course, cost advantages due to these features.

If your future steam requirements call for a high performance boiler, it will pay you to investigate the PCC. It offers utility type boiler quality in a compact package along with the economy and reliability characteristics of C-E design.

THE PCC

Meets these industrial steam needs	with these advantages
• Power generation—with or without process steam requirements.	• Controlled circulation • Quality shop fabrication • Ease of shipment
• High capacity, temperature, pressure.	• Minimum plant down-time for installation
• Maximum generating capacity in limited space.	• Earlier delivery than possible with field erection

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C-E

Combustion Engineering Building — 200 Madison Avenue, New York 16, N.Y.

C-169A

ALL TYPES OF STEAM GENERATING, FUEL BURNING AND RELATED EQUIPMENT; NUCLEAR REACTORS; PAPER MILL EQUIPMENT; PULVERIZERS; FLASH DRYING SYSTEMS; PRESSURE VESSELS; SOIL PIPE

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PUBLISHED BY
THE AMERICAN SOCIETY OF
MECHANICAL ENGINEERS

VOLUME 80 • NUMBER 9 • SEPTEMBER, 1958

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THE COVER

Intercontinental thrust: nozzles designed for the free world's most powerful cluster of rocket engines, driving the Atlas ICBM. Rocketdyne, a division of North American Aviation, Inc., designed the liquid-propellant power system for the 15,000-mph Air Force-Convair Atlas, a vehicle for the fringes of space. Nozzle in the center delivers thrust for high-altitude travel. Boosters—left and right—lift the great missile off the pad, drive it to high speed and high altitude. Booster engines are then jettisoned.

ENGINEERS IN MANAGEMENT? ..... **H. W. Johnson** **46**

You may fail as an executive if you dismiss relevancies as irrelevant, if you avoid politics and the humanities. Can an engineer emerge from his technical rut? At M.I.T. they think he can.

TRAINING FOR THE FUTURE ..... **J. C. Zeder** **48**

Coming up: A whole new philosophy of engineering education, new curriculums soundly rooted in basic science. Tomorrow's graduate engineer will be broad of vision, fast on his scientific feet.

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Regard, now, the cost penalty of a plant shutdown due to lack of a spare part. It hurts. But maintenance supplies run to heavy investment. Engineering analysis can reduce the burden.

HIGH-ENERGY FUELS FOR AVIATION ..... **R. A. Wells** **55**

The project: Develop fuels of higher energy, for greater range and speed in present planes—and for the future power plants of aircraft. Result: A major fuel-technology breakthrough.

HOW TO READ HEAT TRANSFER IN RUSSIAN ..... **F. F. Buckland** **60**

They know our language. We should know theirs. A nonengineer translator, not understanding, may pick the wrong word. Here's a first lesson in Russian, starting with the word for Prandtl.

BEARINGS, LUBRICANTS and LUBRICATION— A DIGEST OF 1957 LITERATURE **64**

Engineers know more about friction and lubrication than they did a year ago. Here's a report on the continuing research, a listing of the technical writings. What really happens in a bearing?

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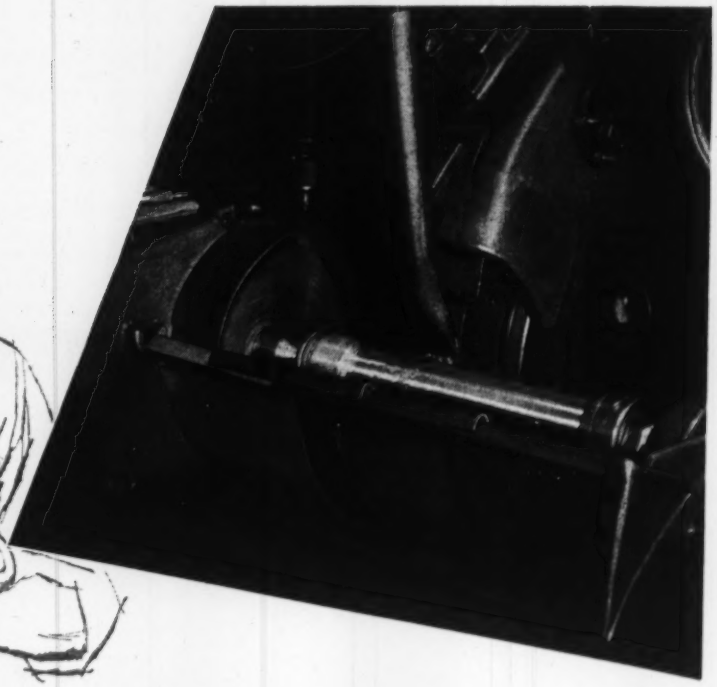

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As a production man, I've tried them all. B&W Tubing consistently leads in ease of machining—keeps our operations on schedule."

B&W welded or seamless tubing—in carbon, alloy or stainless steel—offers the right physical and mechanical tubing characteristics for your method of manufacture.

B&W tailors tubing finish, heat treatment, tolerances and steel quality to product specifications. And that means a smooth running production line, lowered costs.

So if you want expert help in selecting the best tubing for your job, call B&W's Mr. Tubes. This representative or distributor will expedite delivery to you from local stocks.

Or write for descriptive literature TB 347. The Babcock & Wilcox Company, Tubular Products Div., Beaver Falls, Pa.

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Published monthly by The American Society of Mechanical Engineers. Publication office at 20th and Northampton Streets, Easton, Pa. Editorial and Advertising departments at the headquarters of the Society, 29 West Thirty-Ninth Street, New York 18, N. Y. Cable address, "Mechaneer," New York. Price to members annually $3.50 for initial membership subscription; $5.00 for additional subscriptions, single copy 50 cents; to nonmembers annually $7.00, single copy 75 cents. Add $1.50 for postage to all countries outside the United States, Canada, and the Pan American Union. Changes of address must be received at Society headquarters seven weeks before they are to be effective on the mailing list. Please send old as well as new address . . . By-Laws: The Society shall not be responsible for statements or opinions advanced in papers or . . . printed in its publications (B13, Par. 4) . . . Second-class mail privileges authorized at Easton, Penna. . . . Acceptance for mailing at special rate of postage provided for in section 1103, Act of October 3, 1917, authorized on January 17, 1921 . . .
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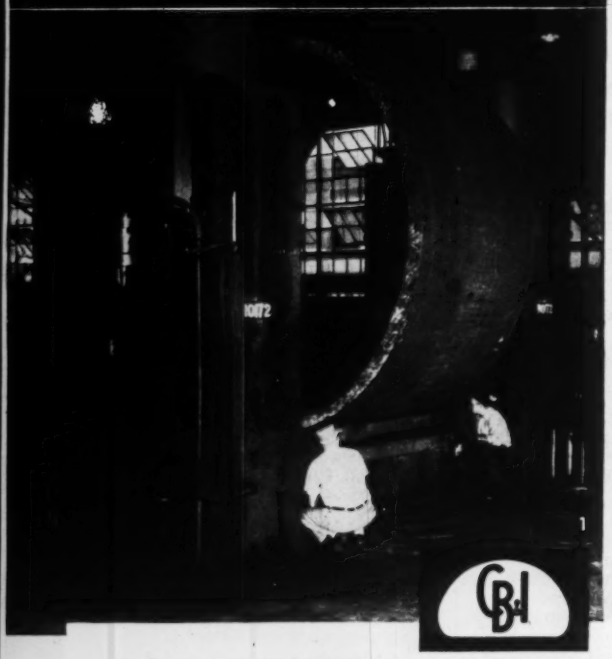
P73CB



1. 5-in. thick plate for reactor is fabricated at CB&I's Birmingham, Alabama plant.

2. Workman smooths seams on an assembled section.

3. X-ray machine for checking seam welds. Machines operating at 1,000,000 and 2,000,000 volts are used to completely inspect steel vessels as much as 10 inches thick.

4. 72-ton top section for reactor-regenerator is lowered into position under supervision of CB&I erection specialist.

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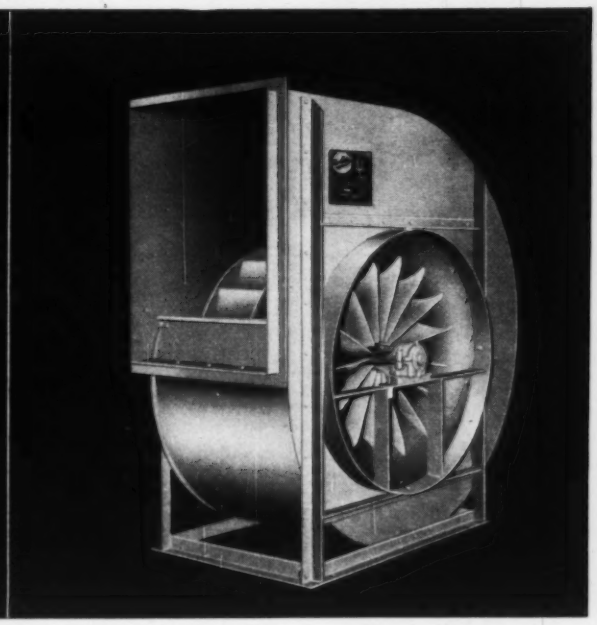
For Classes III-IV (High Pressures) The "Buffalo" Type "BLH" Fan



For Classes I-II (Moderate Pressures) The "Buffalo" Type "BL" Fan

FOR THE BEST ENGINEERED JOBS, SPECIFY BUFFALO "JOB-SUITED" FANS

For central system applications you don't have to accept a "compromise fan", loosely designed to cover any and all pressure requirements. "Buffalo" builds *two* fans, each engineered to fulfill specific pressure requirements to the highest possible degree. Brief engineering details on these "no compromise" "Buffalo" Fans are given below.

The "Buffalo" Type "BLH" Fan is recognized by engineers and contractors alike for its outstanding performance in Classes III and IV service. The "BLH" maintains an extremely high mechanical efficiency of 86% over a broad operating range. The smooth inlet bell with matching shroud, directional inlet vanes, backward-curved blades and divergent outlet all contribute to quiet operation and minimum turbulence. "Buffalo" engineering features, plus husky construction, add up to an efficient high pressure fan that will deliver long, faithful, maintenance-free service. When you plan a conduit system or other Class III-IV installation, be sure to specify the "BLH". Call in your "Buffalo" representative or write for Bulletin F-200.

The "Buffalo" Type "BL" Fan has gained wide acceptance for peak performance in major Class I and II installations throughout the country. Non-overloading, the "BL" provides quiet, stable, output from free delivery to shutoff. The smoothly-curved inlet bell, with directional guide vanes and matching shroud assures minimum turbulence. Highest efficiency is attained by the streamlined wheel with backward curved blades, factory tested and balanced to hold vibration to an absolute minimum. The correctly shaped scroll of the wheel-contoured housing further contributes to smooth air flow. For full information on the rugged, reliable "BL" Fan for Class I and II conditions, contact your "Buffalo" engineering representative. Or, write direct for Bulletin F-104.

You get a *value dividend* with the "Q" Factor – the built-in QUALITY that provides trouble-free satisfaction and long life in *every* "Buffalo" product.

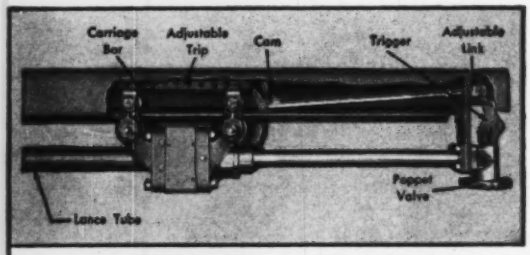
BUFFALO FORGE COMPANY • Buffalo, New York

Buffalo Pumps Division, Buffalo, New York

Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

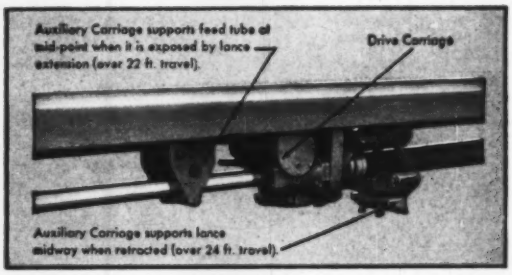
VENTILATING AIR CLEANING AIR TEMPERING INDUCED DRAFT EXHAUSTING FORCED DRAFT COOLING HEATING PRESSURE BLOWING

Reasons FOR THE ENTHUSIASTIC ACCEPTANCE



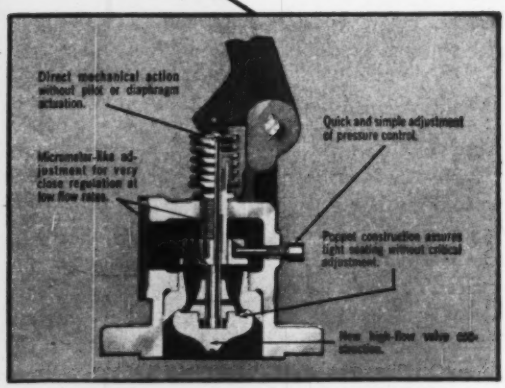
MECHANICALLY OPERATED VALVE

Control of blowing medium is automatic, positive and accurate by means of a simple, dependable mechanically operated valve. As lance begins movement into boiler, trip on carriage opens valve through a linkage. At end of retraction, trip closes valve. All pilot or diaphragm valve elements are eliminated. Trip is adjustable.


Auxiliary Carriage supports feed tube at mid-point when it is exposed by lance extension (over 22 ft. travel).
Drive Carriage
Auxiliary Carriage supports lance midway when retracted (over 24 ft. travel).

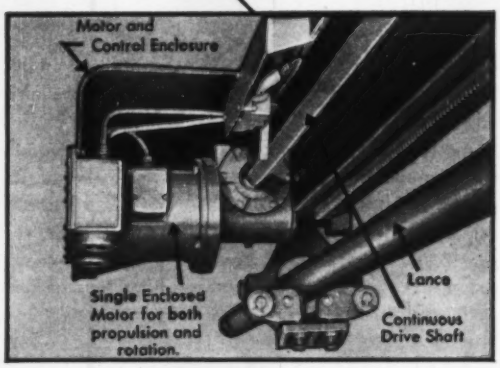
AUXILIARY CARRIAGES (FOR EXTRA LONG TRAVEL)

On extra long blowers, one auxiliary carriage supports lance midway when retracted, preventing undue bending. Second auxiliary carriage is dropped at mid-point to support feed tube when it is exposed by lance extension.


Direct mechanical action without pilot or diaphragm actuation.
Micrometer-like adjustment for very close regulation at low flow rates.
Quick and simple adjustment of pressure control.
Poppet construction assures tight seating without critical adjustment.

POPPET VALVE WITH ADJUSTABLE PRESSURE CONTROL

Diamond dependable poppet valve with improved streamlined flow contours and adjustable pressure control that permits easy, accurate setting of pressure at individual valve and independent of other blowers. Poppet construction assures tight seating without critical adjustment. Stem, seat and disc are stainless steel. Stellited seating surfaces are available.



STATIONARY GEAR MOTOR

Lance propulsion and rotation are by a *single* enclosed gear motor which drives a continuous shaft running the full length of blower and providing power to carriage. This construction makes it possible to mount motor in a fixed position at the front end for better protection and accessibility.

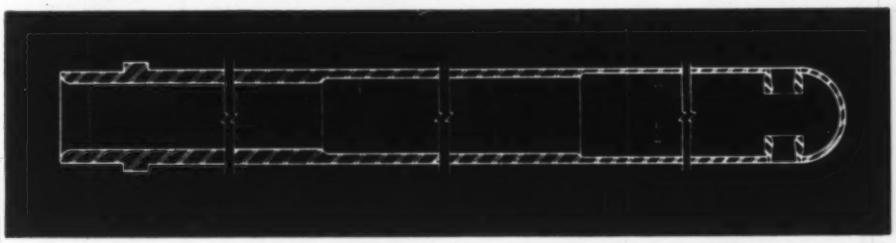
8077

DIAMOND POWER

of the DIAMOND SERIES 300 IK
LONG RETRACTING BLOWER

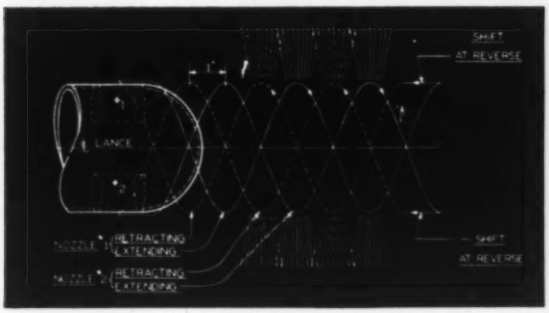
The Diamond Series 300 IK Blower sets a new and higher standard of efficiency, economy and dependability in the cleaning of heating surfaces that require a long retracting lance type blower. Pointed out in detail are some of its important features. Others are a *single* outboard support point to simplify installation and the attractive "backbone" cover for greater rigidity and protection of the entire blower assembly from dirt, damage, the elements and personnel hazards.

This new Series 300 IK is the culmination of more than 20 years' experience building and applying long travel blowers. It well illustrates the Diamond design philosophy: *"Keep it simple . . . keep it basic . . . avoid unnecessary complications."* It is further evidence of the fact that YOU CLEAN BOILERS BETTER AND AT LOWER COST WITH DIAMOND BLOWERS.



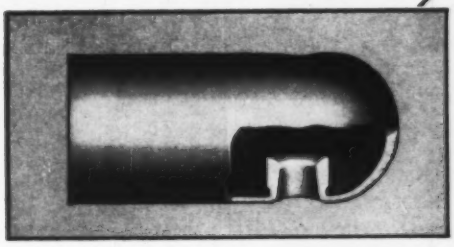
STEP-TAPER LANCE
(FOR EXTRA LONG TRAVEL)

Extra long lance has minimum droop due to step-taper construction which employs up to four different wall thicknesses. Lightest wall is at nozzle end to reduce bending moment. Lance is chrome alloy for heat resistance.



IMPROVE CLEANING PATTERN

Close and positively controlled helical cleaning pattern assures maximum cleaning effectiveness. Blowing pattern diagram illustrates how return travel path is exactly intermediate with forward travel path so that there is a *positive nozzle sweep every inch.*

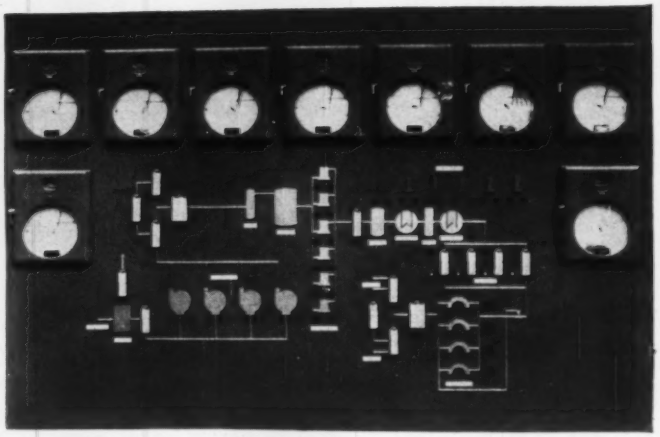


IMPROVED DIAMOND NOZZLE

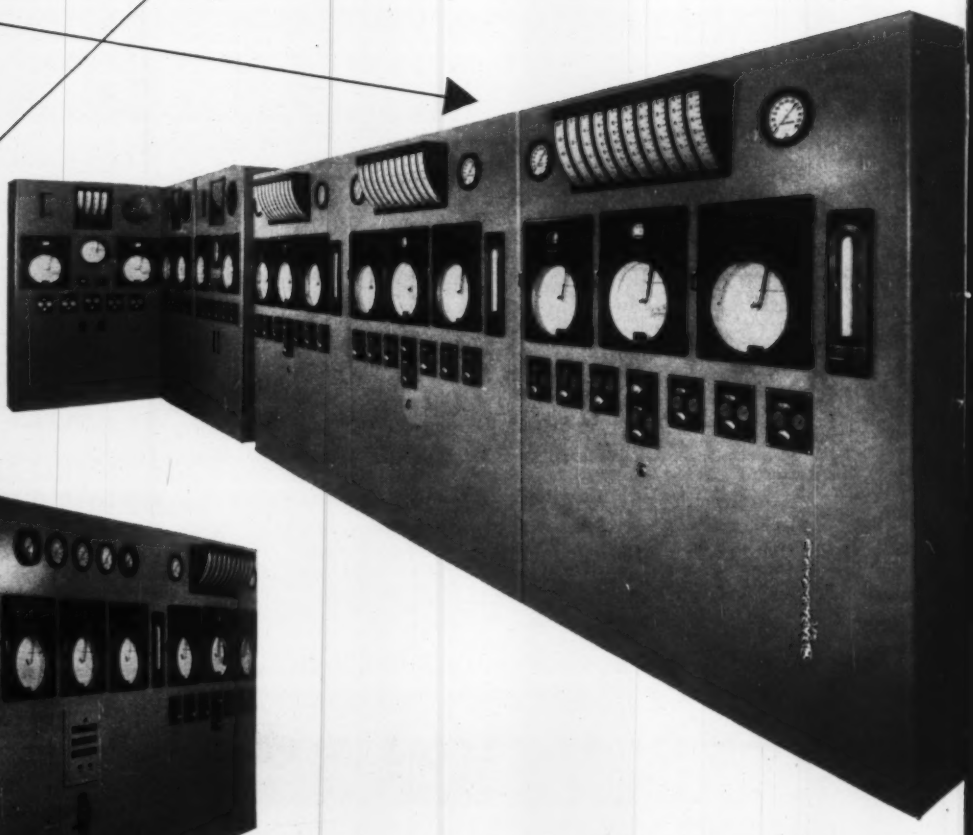
New design Diamond "Type A" Nozzle is the result of several years' research and the testing of more than 50 different contours. The modified venturi produces maximum impact pressure and cleaning effectiveness with minimum expenditure of cleaning medium. (Steam or compressed air.)

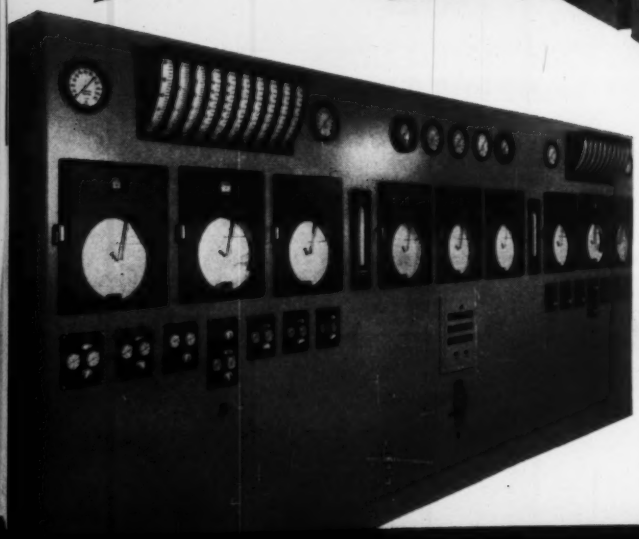
For further information, ask the nearest Diamond office or write directly to Lancaster for Bulletin 2111AA.

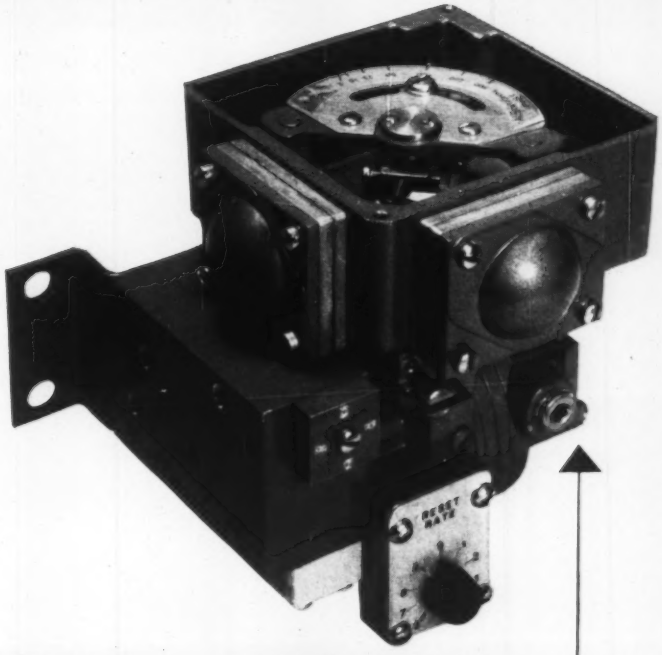
SPECIALTY CORP. **LANCASTER, OHIO**
DIAMOND SPECIALTY LIMITED—Windsor, Ontario



Base Any Of These....







ON THIS

For accurate, efficient, dependable control systems— new Rockwell-Built REPUBLIC TYPE "VC" PNEUMATIC CONTROLLER

Here is an all purpose null-balance-vector controller for use with any pneumatic transmitter. Its proportional band ranges from 2% to 500% *without changing parts*, for quick adaptation to changes in process requirements. Especially important in high-precision control, Republic's Type VC has exceptional sensitivity and a narrow dead band (less than 0.05%). Its high capacity non-bleed pneumatic amplifier consumes little air, keeps output ample. A selector block permits reverse or direct action. Local or remote pneumatic set point optional.

Companion instruments—using an identical null-balance-vector "heart"—include differential pressure, temperature and pressure transmitters . . . ratio, totalizing, multiplying, squaring and square - root - extracting relays. Many parts are interchangeable among the instruments in this "family". Besides reducing spare parts inventory, the similarity of components simplifies the task of training personnel.

Let a Republic engineer show you how these instruments can help to achieve accurate, efficient, dependable control systems. Sales offices in principal cities throughout the U.S. and Canada. Write to Republic Flow Meters Company (subsidiary of Rockwell Manufacturing Company), 2240 Diversey Parkway, Chicago 47, Illinois. In Canada: Republic Flow Meters Canada, Ltd., Toronto.

REPUBLIC INSTRUMENTS AND CONTROLS

more fine products by

ROCKWELL

WICKES TYPE S-1AL

HEAT ONE OF AMERICA'S

STEAM GENERATORS
MOST MODERN BUILDINGS

CONNECTICUT GENERAL LIFE INSURANCE CO., Bloomfield, Conn.

ARCHITECTS:
Skidmore, Owings & Merrill

GENERAL CONTRACTOR:
Turner Construction Co.

MECHANICAL CONTRACTOR:
Kerby Saunders, Inc.

A recent exhibit at the National Gallery features 10 of America's most modern buildings. The American Institute of Architects, on the occasion of its Centennial, included in the exhibit the new home office of the Connecticut General Life Insurance Company in suburban Hartford, which is equipped with Wickes boilers. This spacious, sun-flooded building of steel and glass, is nearly a modern city in itself, for it houses not only the complete office system, but includes employee lounges, game rooms, medical department, mailrooms, auditorium, bowling alleys, barber and beauty shops as well.

For the heating system in this mammoth structure, engineers chose to install two Wickes type S-1AL steam generators equipped with both oil and gas burners. In addition to general heating, the steam generators provide power to operate the refrigeration machines and a snow-melting system on the truck ramp. The boilers each have 3700 sq. ft. of heating surface, and were designed for a maximum continuous load of 27,500 pounds of steam per hour at 200 PSIG.

Bulletin No. 55-1 gives complete facts on Wickes products. New engineering bulletins on Type-S and Type-A Steam Generators are also available on request.

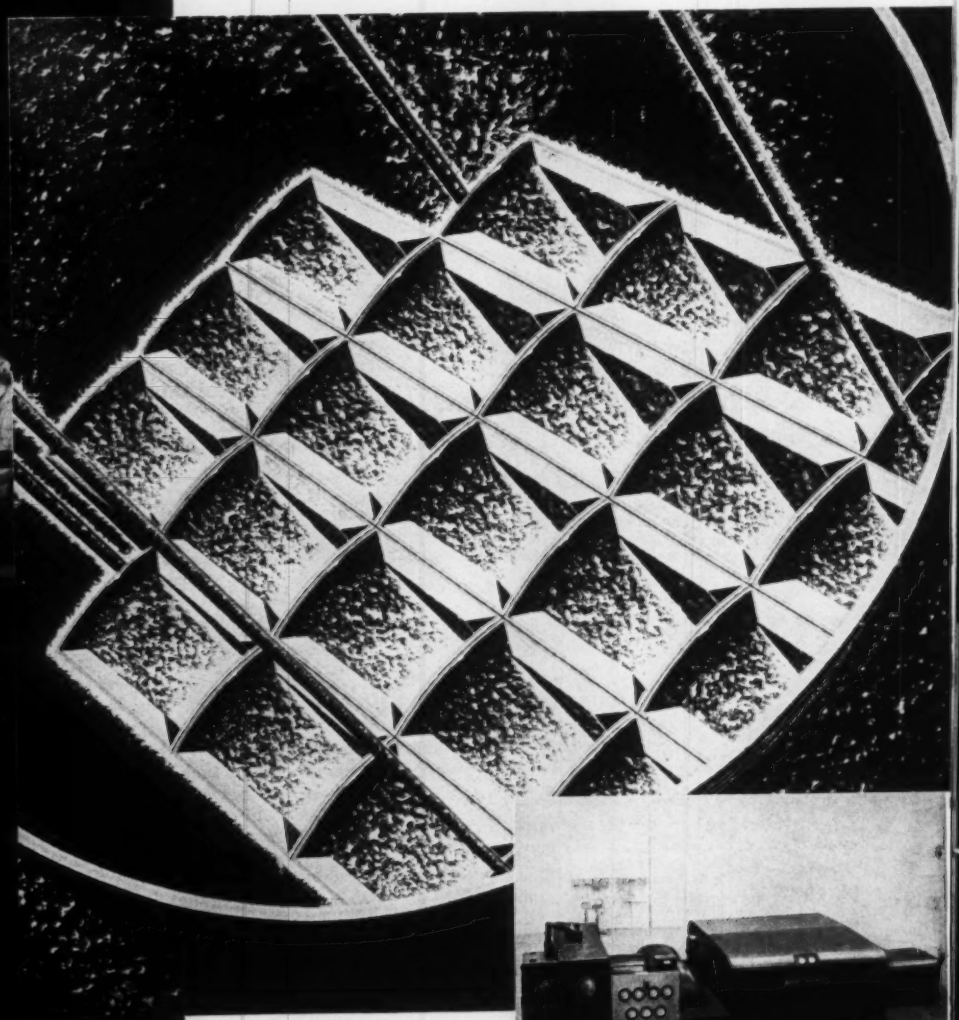
WICKES

WICKES BOILER CO.

DIVISION OF THE WICKES CORPORATION, SAGINAW, MICHIGAN

RECOGNIZED QUALITY SINCE 1854 • SALES OFFICES: Boston • Chicago • Cleveland • Dallas • Denver • Detroit • Houston Indianapolis • Los Angeles • Memphis • Milwaukee • New York City • New Orleans • Portland, Ore. • Saginaw San Francisco • Springfield, Ill. • Tulsa

NUCLEAR



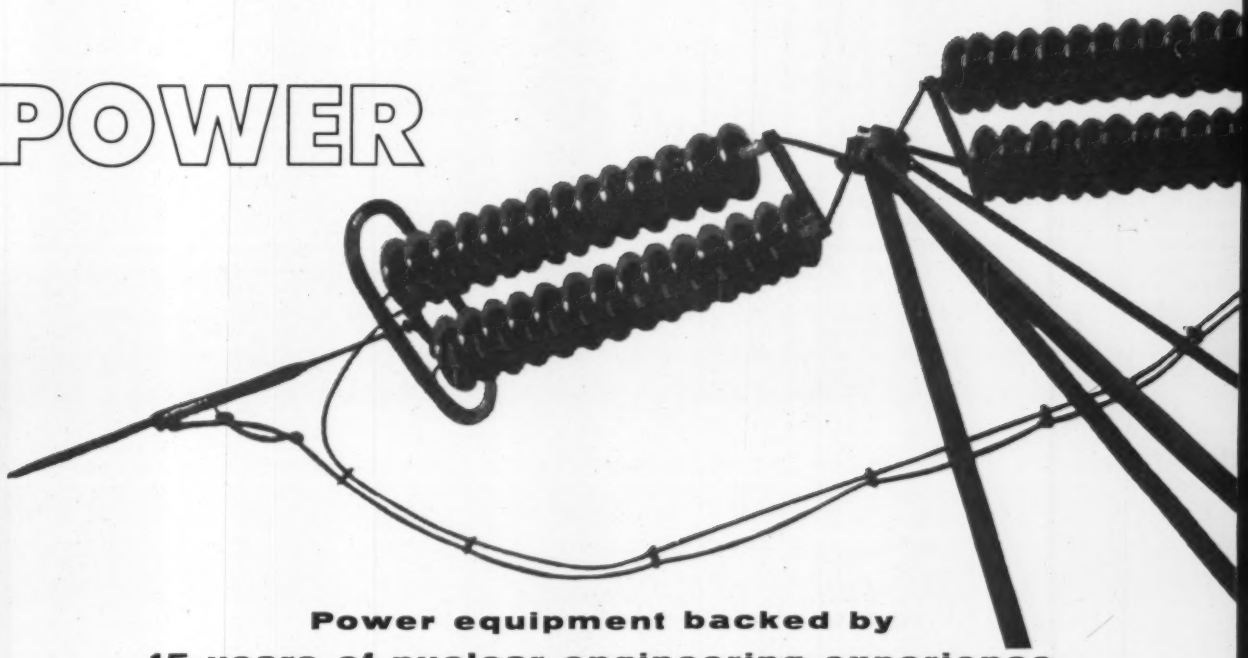
Reactors

Steam Turbine Generators

A-C
ALLIS-CHALMERS

A-5790

POWER



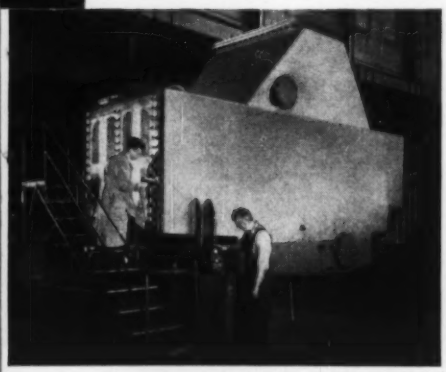
Power equipment backed by
15 years of nuclear engineering experience

ALLIS-CHALMERS development of nuclear reactors and allied equipment is a logical outgrowth of 75 years of building basic power equipment.

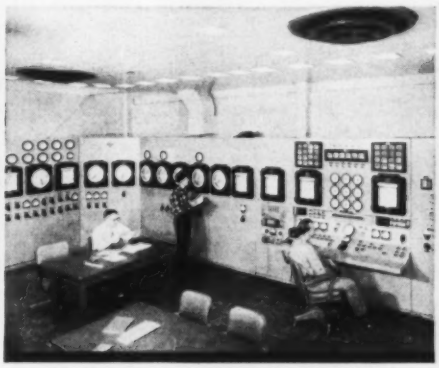
With nuclear experience dating back to the Manhattan Project, facilities, engineering, and production skills are being utilized to produce nuclear power equipment with the same high standards that identify A-C steam turbine generators, condensers, pumps, water conditioning equipment, control, switchgear, breakers, and transformers.

Allis-Chalmers is now engaged in the design and will construct a 66,000-kilowatt nuclear power plant* for the Northern States Power Company in cooperation with ten other electric companies.

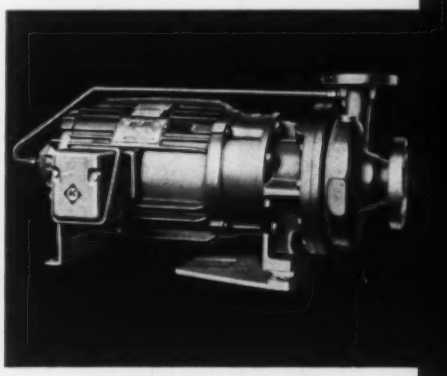
Equipment and engineering for all nuclear power plant needs . . .



Condensers



Control and Switchgear



Nuclear Pumps

ALLIS-CHALMERS

*A model of a nuclear power plant using a Controlled Recirculation Boiling Reactor with nuclear superheater will be featured in the Allis-Chalmers exhibit in the United States Exhibition Area, Geneva Atoms for Peace Exhibition.

POWELL

world's largest family of valves

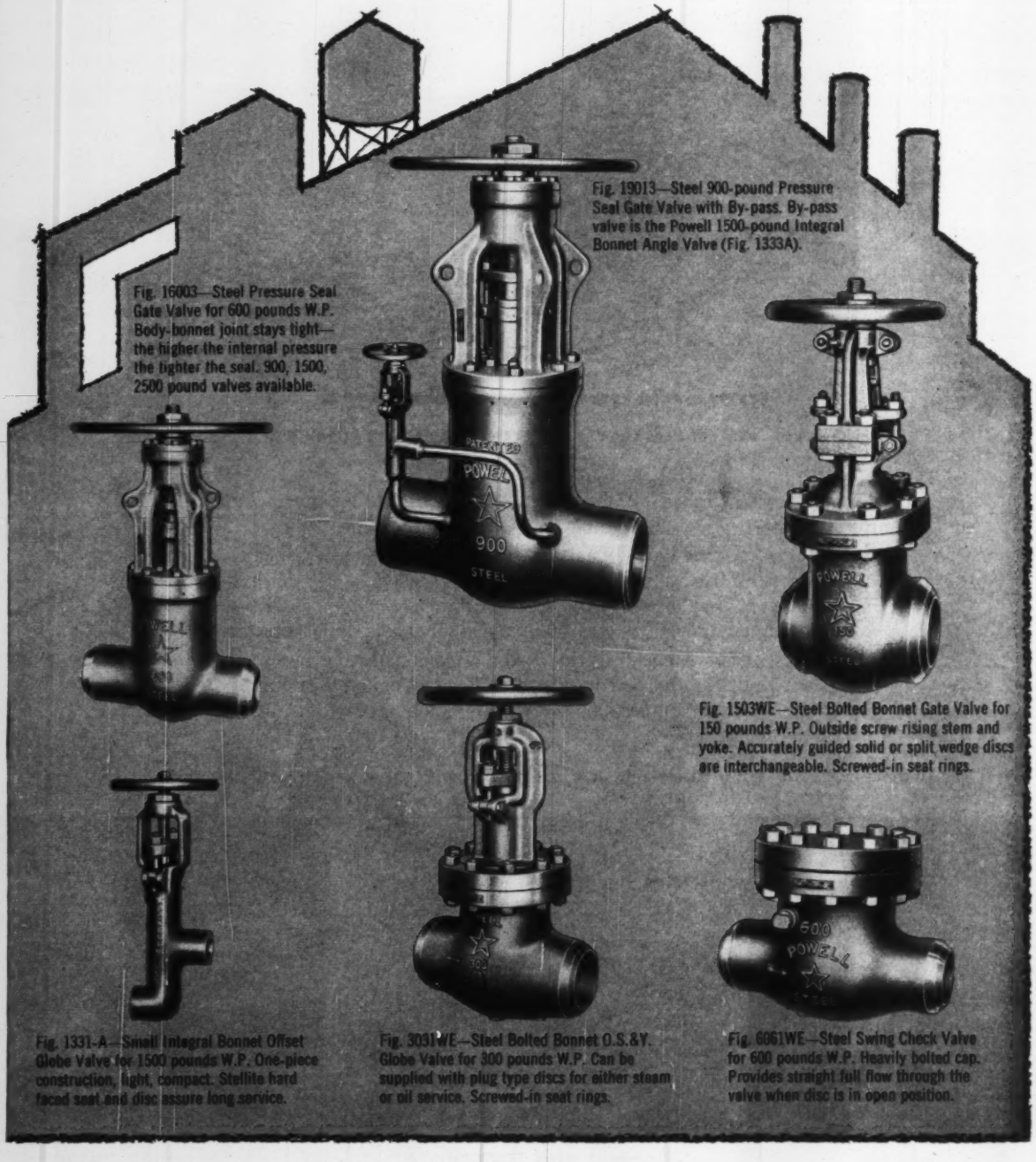


Fig. 19013—Steel 900-pound Pressure Seal Gate Valve with By-pass. By-pass valve is the Powell 1500-pound Integral Bonnet Angle Valve (Fig. 1333A).

Fig. 16003—Steel Pressure Seal Gate Valve for 600 pounds W.P. Body-bonnet joint stays tight—the higher the internal pressure the tighter the seal. 900, 1500, 2500 pound valves available.

Fig. 1503WE—Steel Bolted Bonnet Gate Valve for 150 pounds W.P. Outside screw rising stem and yoke. Accurately guided solid or split wedge discs are interchangeable. Screwed-in seat rings.

Fig. 1331-A—Small Integral Bonnet Offset Globe Valve for 1500 pounds W.P. One-piece construction, light, compact. Stellite hard faced seat and disc assure long service.

Fig. 3031WE—Steel Bolted Bonnet O.S.&Y. Globe Valve for 300 pounds W.P. Can be supplied with plug type discs for either steam or oil service. Screwed-in seat rings.

Fig. 6061WE—Steel Swing Check Valve for 600 pounds W.P. Heavily bolted cap. Provides straight full flow through the valve when disc is in open position.

For every flow control problem Powell offers more kinds or types, available in the largest variety of metals and alloys to handle every flow control requirement. Powell distributors are located in all principal cities and maintain inventories to fill almost any need. For special engineering problems, write direct to:

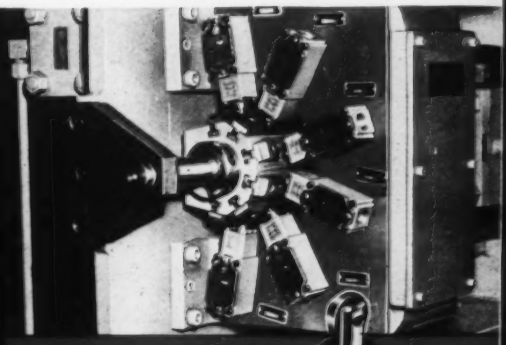
THE WM. POWELL COMPANY • *Dependable Valves Since 1846* • **Cincinnati 22, Ohio**

ALLEN-BRADLEY

BULLETIN 802T

OILTIGHT

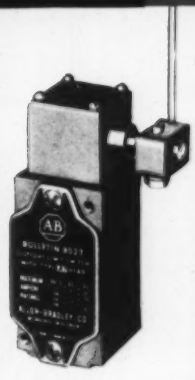
LIMIT SWITCHES



Radial mounting of six Allen-Bradley "manifold" type, push roller, oiltight limit switches.

SIDE PUSH ROD

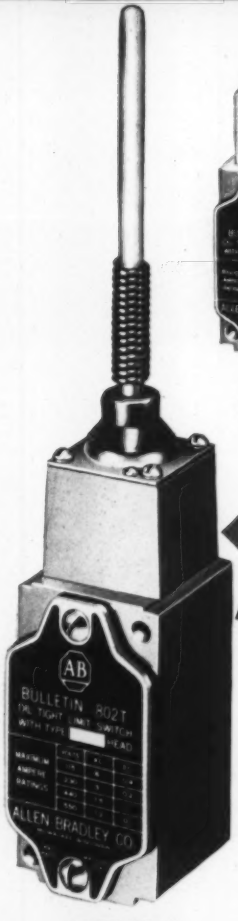
FORK LEVER TYPE



ADJUSTABLE ROD

TOP PUSH ROD WITH PLASTIC WINDOW

Push roller, oiltight limit switch, showing rubber grommeted wiring hole on back of "manifold" type, used on above automatic production machine made by Cross Company, Detroit.



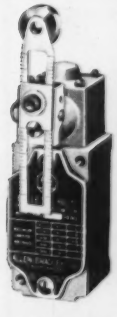
WOBBLE STICK TYPE

← OIL SEALED HEAD
AND BODY

assure reliable operation

Completely sealed . . . oil, dirt, and metal chips cannot foul up contacts or operating mechanism. Operating heads are interchangeable—can be mounted in any one of four positions. New "wobble stick" heads operate in any direction. All of these limit switches have maintenance free, double break, silver alloy contacts. Specify Allen-Bradley—the *quality* line of limit switches.

ROLLER LEVER FOR CAVITY MOUNTING



ADJUSTABLE ROLLER LEVER

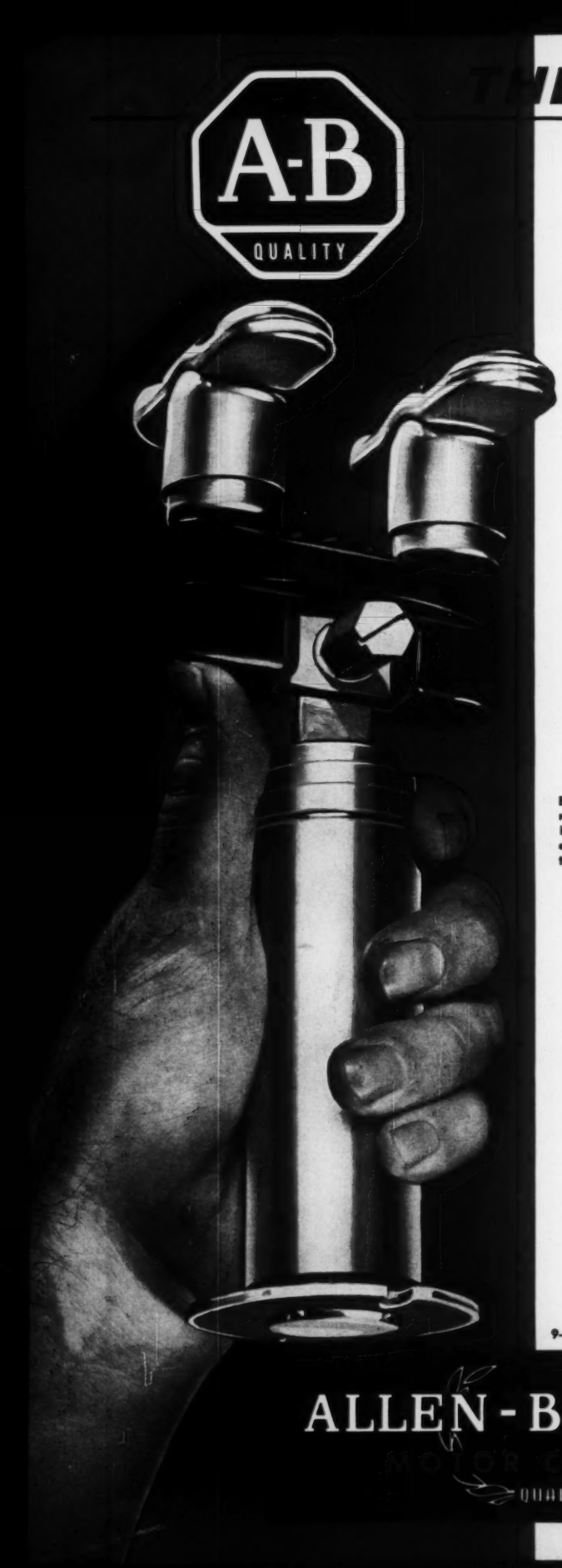
A-B QUALITY

ALLEN-BRADLEY

MOTOR CONTROL

QUALITY

Allen-Bradley Co., 1318 S. Second St., Milwaukee 4, Wis.
In Canada: Allen-Bradley Canada Ltd., Galt, Ont.



THE ONLY LINE OF

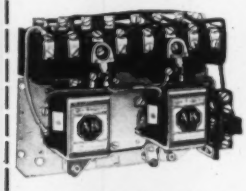
D. C.
MOTOR STARTERS
with modern
SOLENOID CONTACTORS

With Allen-Bradley, you get D. C. motor control that is *completely modern!* It uses the simplest switching mechanism yet conceived . . . the solenoid contactor with only ONE moving part. There are no bearings to stick . . . no jumpers to break. This assures millions of trouble free operations. And the double break, silver alloy contacts never need maintenance. Available in ratings up through Size 4. Write for details.

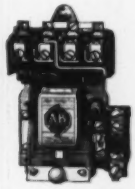
CONTACTORS

Bulletin 202 solenoid type contactor. In ratings to 150 amp. Also, clapper type to 600 amperes.

FULL VOLTAGE STARTERS

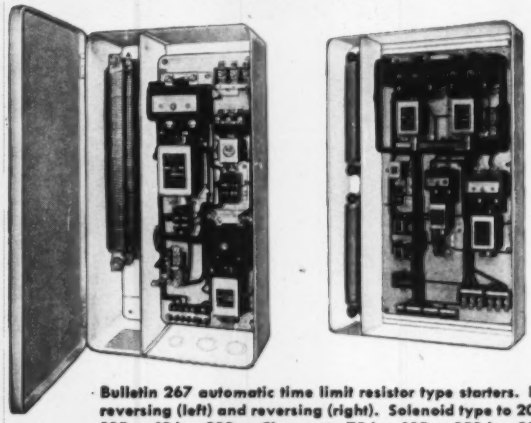


Bulletin 205 full voltage reversing starter. Ratings to 1½ hp, 115 v; 2 hp, 230 v.



Bulletin 209 full voltage starter. Available in ratings up to 1½ hp, 115 v; 2 hp, 230 v.

REDUCED VOLTAGE STARTERS



Bulletin 267 automatic time limit resistor type starters. Non-reversing (left) and reversing (right). Solenoid type to 20 hp, 115 v; 40 hp, 230 v. Clapper to 75 hp, 115 v; 150 hp, 230 v.

9-58-MR

ALLEN-BRADLEY
MOTOR CONTROL
QUALITY

MAIN OFFICE and Factory
1316 S. Second St.
Milwaukee 4, Wis.

In Canada: Allen-Bradley Canada Ltd., Galt, Ontario

Now . . . you can confidently specify metallic bellows for even the toughest combination of environmental and service conditions . . . and get the most accurate and reliable bellows ever built!

Now . . . service limits are greatly increased by a wider choice of bellows metals, including Inconel-X, titanium, zirconium, Hastelloys, Monels, Ni-Span-C, 17-7 PH and 300 and 400 stainless steels, beryllium copper, super corrosion resisting and other weldable alloys.

Precision welding results in exacting control of dimensional tolerances on free length, I.D., O.D., parallelism of plates and end fittings, and concentricity of end fittings. Improved properties in FORMWELD Bellows include greater temperature, corrosion and fatigue resistance, ability to withstand higher loads without deformation, lower hysteresis with greater linearity, and complete uniformity of properties. More free plates per inch assure space savings. Available in sizes from ¼" to 18" plus O.D.

WRITE FOR BULLETIN D-709

Mr. Controls®

Robertshaw-Fulton
CONTROLS COMPANY

BRIDGEPORT THERMOSTAT DIVISION
Milford, Connecticut

From pit to plant, LeTourneau—

New 400 HP LW-80—world's largest coal hauler—is 12' high by 12' wide, 54½' long. It hauls 100 cubic yards (80 tons) per trip at speeds up to 34 mph.

Westinghouse moves with coal

Earthmoving equipment manufacturer estimates steam generated from coal costs only half as much as competitive fuels

At LeTourneau-Westinghouse Co., Peoria, Ill., steam is used to heat an area that has swelled to a million square feet of space. Increasing demand created the need for a modern heating plant to replace obsolete equipment. When plans were drawn for the new plant, fuel surveys indicated that the firm should continue to use coal for availability and economy. Estimates showed that steam produced from burning coal in this area costs about *half as much* as from competitive fuels.

Today LeTourneau-Westinghouse has found that burning coal in modern equipment cuts costs in several ways. Fuel costs, of course, are at a minimum. Automatic, efficient operation has lowered coal and ash handling costs. And manpower requirements have been reduced from 12 to 7 men.

Facts you should know about coal

You'll find that bituminous coal is not only the lowest-cost fuel in most industrial areas, as in the case of LeTourneau-Westinghouse, but up-to-date coal burning equipment can give you 15% to 50% more steam per dollar. Today's automatic equipment can pare labor costs and eliminate smoke problems. And vast coal reserves plus mechanized production methods mean a constantly plentiful supply of coal at stable prices.

Technical advisory service

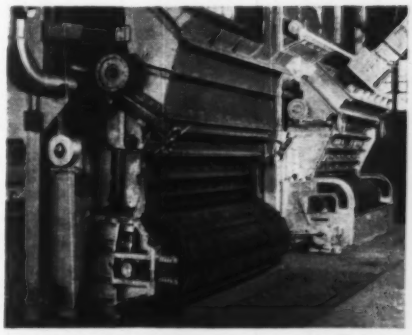
To help you with industrial fuel problems, the Bituminous Coal Institute offers a free technical advisory service. We welcome the opportunity to work with you, your consulting engineers and architects. If you are concerned with steam costs, write to the address below. Or send for our case history booklet, complete with data sheets. You'll find it informative.

Consult an engineering firm

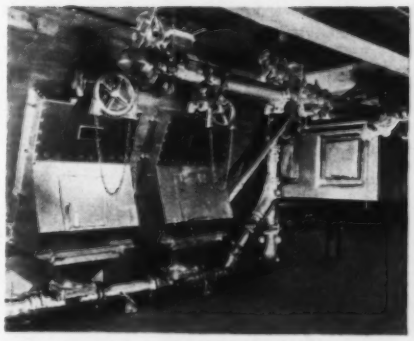
If you are remodeling or building new heating or power facilities, it will pay you to consult a qualified engineering firm. Such concerns—familiar with the latest in fuel costs and equipment—can effect great savings for you in efficiency and fuel economy over the years.

BITUMINOUS COAL INSTITUTE

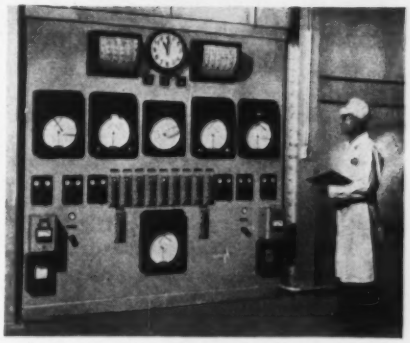
Department ME-09
Southern Building, Washington 5, D. C.



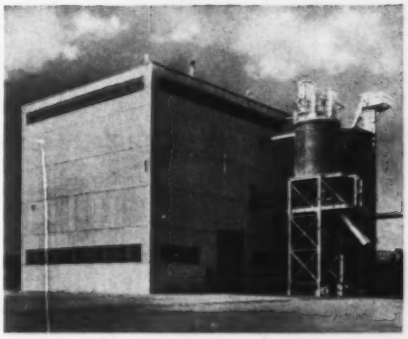
View in the LeTourneau-Westinghouse heating plant. In foreground is an Erie City 40,000 lb/hr type I.W.T. boiler which is used on stand-by basis and for peak loads in extremely cold weather. At the right rear is Erie City 60,000 lb/hr main boiler. Both are fired by Combustion Engineering Inc. traveling grate stokers.



Shown are ash hoppers, part of United Conveyor ash handling system. Ashes are dumped from ash pits into hoppers from where they are piped pneumatically to silo. This system also handles dust from Prat-Daniel dust collectors.

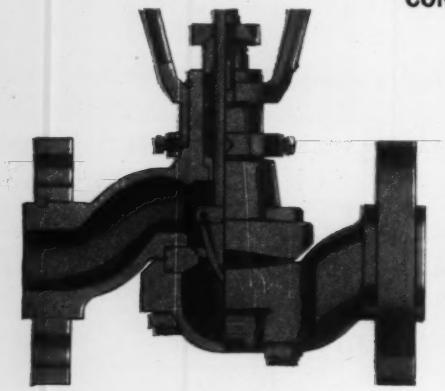


Bailey Control Panel regulates both boilers, including boiler meters and recorders, feedwater controllers and alarms, drum level recorders and alarms, multipointer gages for draft control and return condensate recorders.

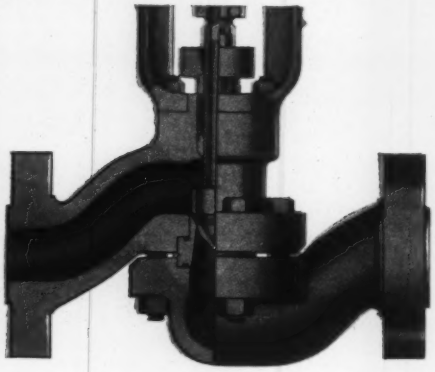


New heating plant showing 9000 cu ft Kalamazoo Tank & Silo Co. coal silo (on right). Coal feeds from railroad car into track hopper, then moves by screw conveyor to 40 ton/hr bucket conveyor which elevates coal to top of silo. Entire coal handling system by Beaumont-Birch Co. To left of coal silo is Kalamazoo 25-ton ash silo equipped with United Conveyor dustless rotary unloader.

CONTROL VALVE BODY
600 lb ASA rating

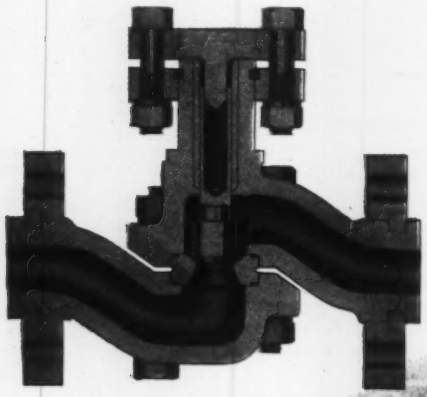


CONTROL VALVE BODY 900 and 1500 lb ASA ratings

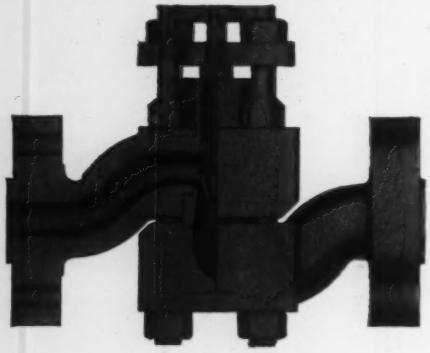


MOLTEN METAL VALVE BODY

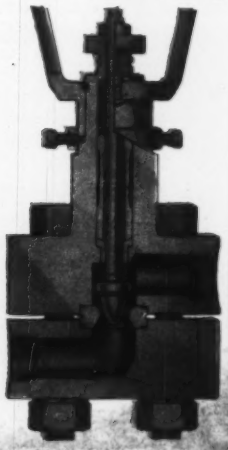
CHECK VALVE BODY
600 to 2500 lb ASA ratings



CONTROL VALVE BODY
2500 and 10,000 lb ratings



CONTROL VALVE BODY
2500 and 10,000 lb ratings

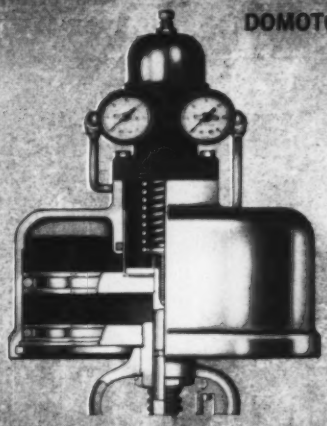


In all the world of process control
there is no better valve design
for function and reliability

THE *Annin*

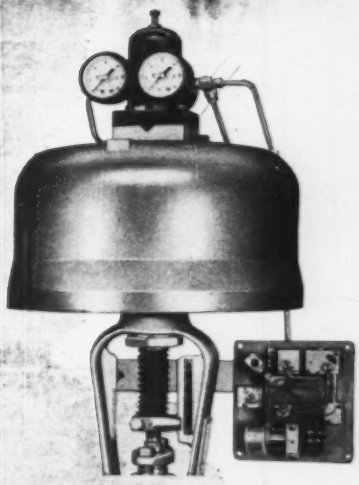
1040 SOUTH VAIL AVENUE, MONTEBELLO, CALIFORNIA

SEE ANNIN VALVES ON DISPLAY AT THE 13TH ANNUAL ISA INSTRUMENT-



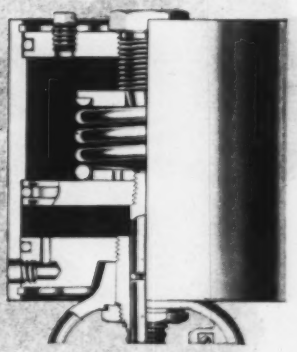
DOMOTOR OPERATOR

GOAL..... CONTROL?



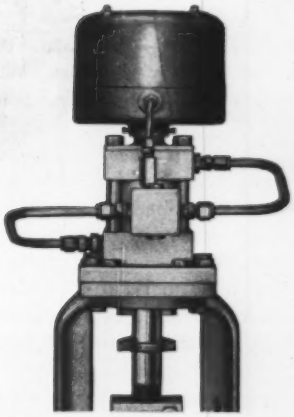
ELECTRO-PNEUMATIC DOMOTOR OPERATOR

ANNIN VALVE BODIES AND OPERATORS

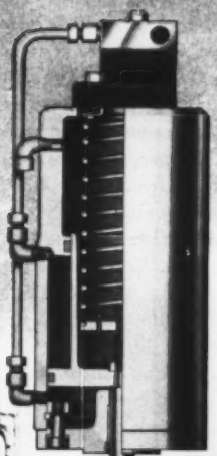


CYLINDER OPERATOR

PNEUMATIC-HYDRAULIC OPERATOR



ELECTRO-HYDRAULIC OPERATOR



STROKE POSITIONING OPERATOR

COMPANY

DIVISION OF THE ANNIN CORPORATION

AUTOMATION CONFERENCE AND EXHIBIT, SEPTEMBER 15-19, PHILADELPHIA, PA.

Formability—In days of old, when knights were bold, they also were smart. When their very lives depended on a tool or a weapon, they made sure it was made from steel. It could be a great claymore, hefty enough to behead a horse; a bright suit of armor that would turn the Saracen's arrow; or an ornamental castle gate, strongly made to frustrate the assassin.

They wanted steel because it was strong. They could *use* it because it was formable. Truly, there is no economical metal in all the world that can approach steel's combination of strength and formability.

With the near-magic of heat treating, you can soften steel and form it, then harden it to make it strong, then temper it to make it tough. Or form it cold. Use bending, flanging, deep drawing, spinning, cold heading, die drawing, rolling, wiper forming, draw rolling, stretch forming or bumping. In fact, it's hard to imagine any forming operation that cannot be performed on steel.

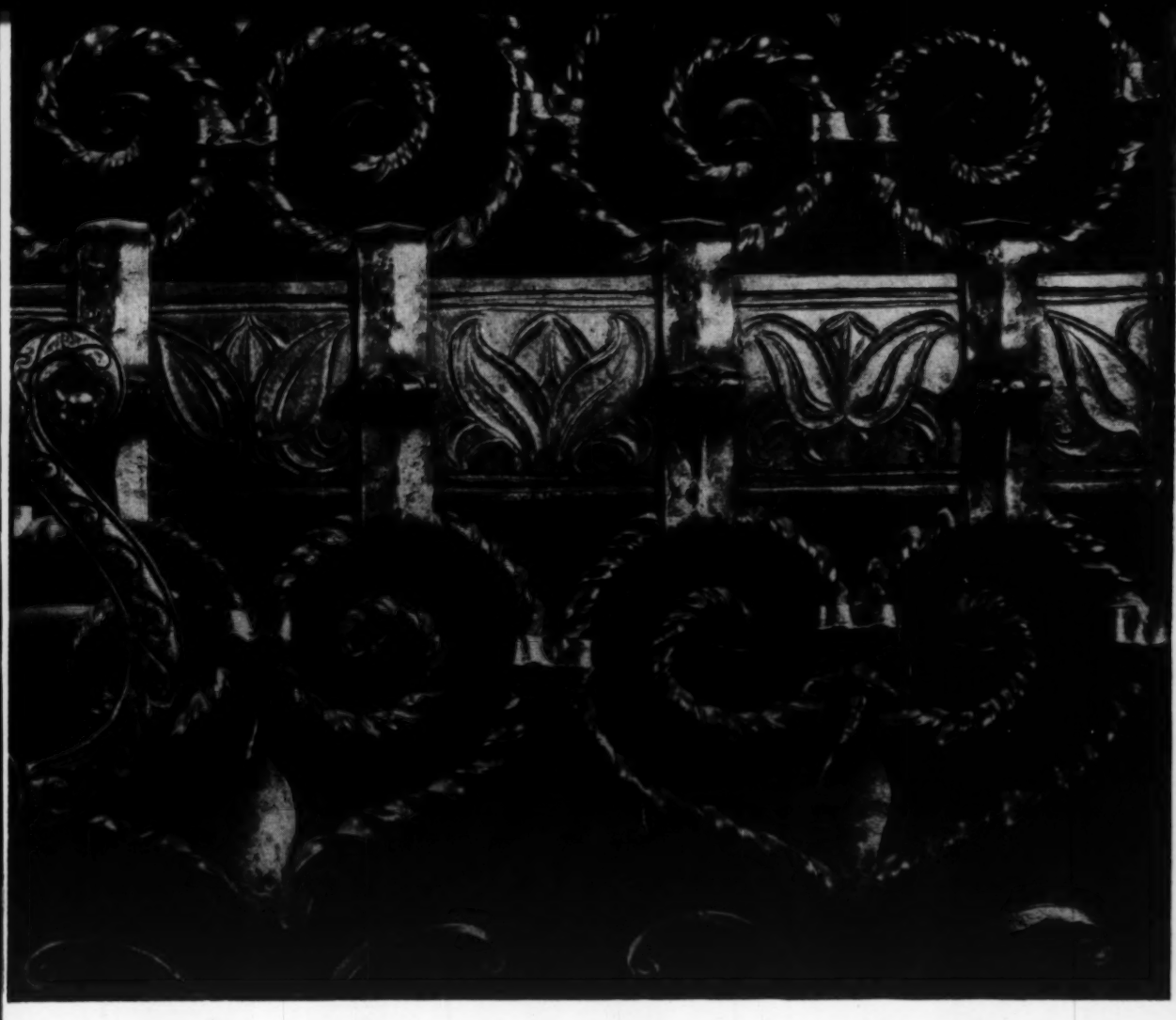
Fortunately, there are hundreds of different kinds of steel; and they all act differently in the fabricating shop. Everything you do to steel alters its *forming* properties, and every forming operation alters its physical properties.

The aim of the product designer is to find a steel that can be properly formed, that has the right strength, toughness, corrosion resistance, weldability or other characteristics required . . . at the most favorable cost. If you have a design problem and the comptroller is looking over your shoulder, take hope from this idea: there is one "best" steel for any design application. You can be sure of finding it among the great family of USS Design Steels: Carbon, High Strength, Alloy and Stainless Steels.

If you need help in making your selection, ask a company that has produced well over a billion tons of steel, and has spent hundreds of millions of dollars to learn more about this most versatile of man's metals. Of course that means United States Steel Corporation, 525 William Penn Place, Pittsburgh 30, Pennsylvania.

United States Steel Corporation • American Steel & Wire • Columbia-Geneva Steel • National Tube
Tennessee Coal & Iron • United States Steel Supply • United States Steel Export Company

USS United States Steel



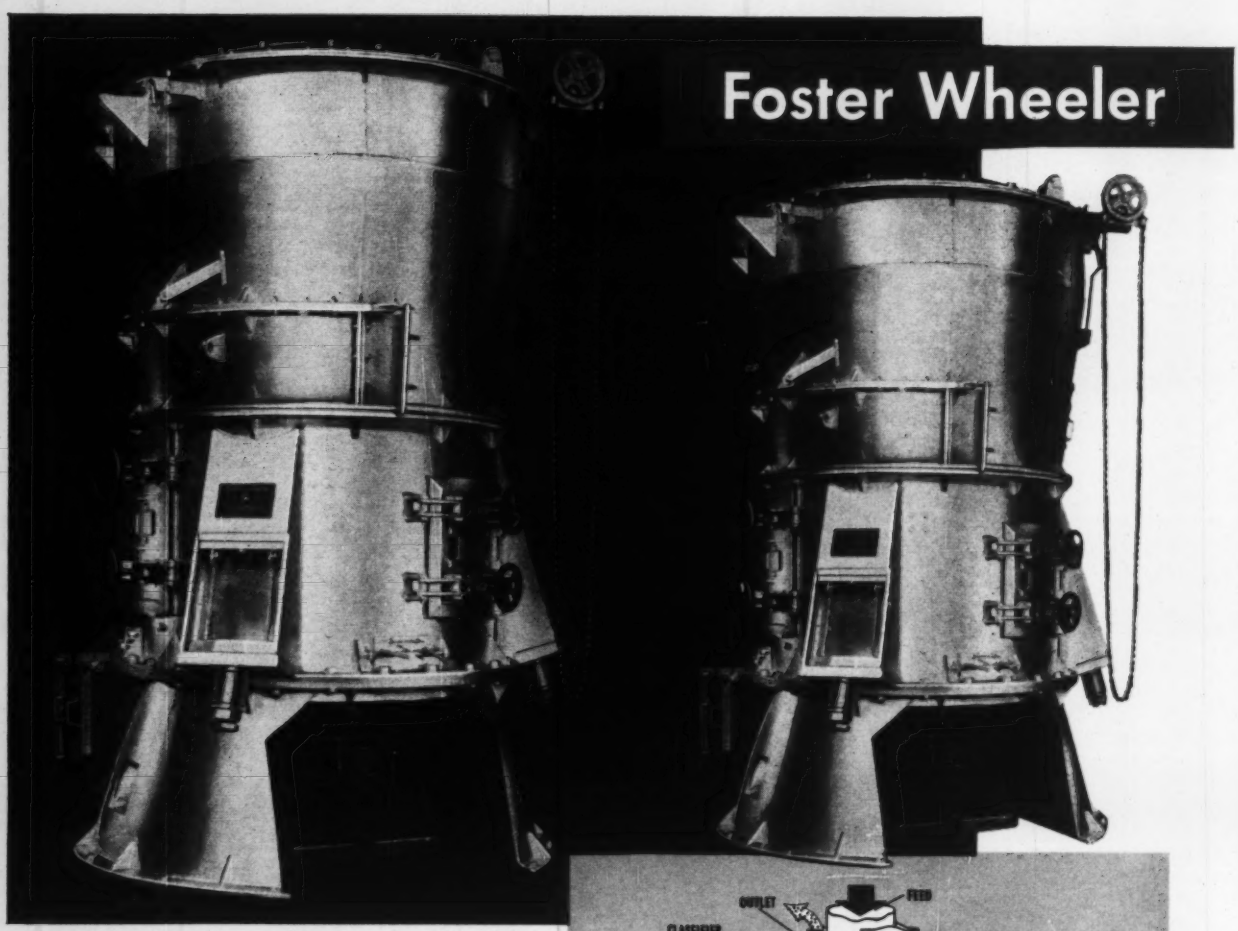
Lower Left—Problem: Build a power shovel dipper stick with greater strength and shock resistance. Solution: Bucyrus-Erie Company designed a tubular stick made from USS "T-1" Constructional Alloy Steel. Payoff: The "T-1" Steel plates were easily cold-formed into a tube and butt welded. The tubular design and stronger steel assured great strength and shock resistance, and easy fabrication.

Lower Middle—Problem: Produce strong, heat resistant, corrosion resistant jet engine rings—*economically*. Solution: Alloy Manufacturing Company carefully selected a grade of USS Stainless Steel. Payoff: The rings resist heat and corrosion and they are economically roll-formed because the Stainless Steel is formed on "carbon steel rated" equipment.

Lower Right—Problem: Design a pressure tank that is just as strong but lighter than conventional carbon steel tanks. Solution: Manufacturer selected USS MAN-TEN High Strength Steel. Payoff: MAN-TEN's greater strength (50% higher yield point than carbon steel) permitted design of a thinner-walled tank that is 24% lighter. And because MAN-TEN is highly formable, the tank is economically produced by cold press forming of circular blanks into seamless shells, 29′ in diameter and 24″ deep.

USS, "T-1" and Man-Ten are registered trademarks

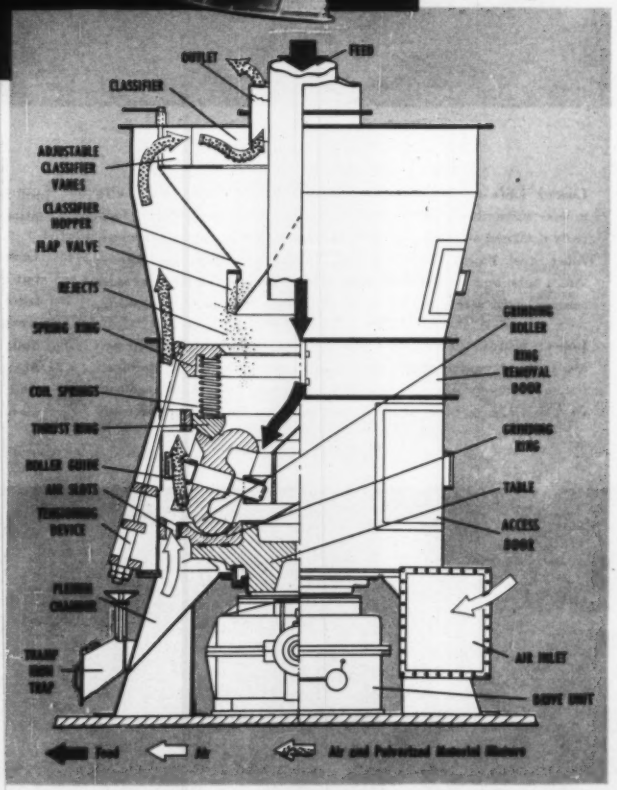
USS



HOW THE MB PULVERIZER WORKS

In the MB Pulverizer, grinding action takes place between a slowly rotating horizontal table and three spheroidal rollers, uniformly spaced around the table and loaded by the adjustable thrust of a large number of heavy coil springs. The power driven table causes the rollers to rotate while circling planet fashion and rolling over the material on the table. The rollers move up and down independently of each other as required to compensate for foreign matter in the charge.

The charge, entering the mill, is fed directly onto the grinding table, where it is crushed between the table and the rollers. Air entering from below the pulverizer table, floats the ground particles up into the classifier, located in the top of the housing. Particles too coarse to be carried to the classifier fall back onto the table for further pulverization. The classified pulverized fuel is discharged through the outlet at the top of the casing.



"MB" PULVERIZERS

offer proved advantages of

LOW POWER CONSUMPTION and LESS MAINTENANCE

Planetary Roll and Table Design, with 9 years of successful operating experience in Europe, now available in capacities up to 60 tons per hour

THE FOSTER WHEELER Type MB Pulverizer is a simple, compact, planetary roll and table mill for pulverizing solid fuels to commercial fineness with exceptionally low power consumption, low maintenance cost and high availability.

Introduced in Europe in 1949, this type of mill has now had nine years of service experience, with excellent performance records and outstanding economy of operation. Its proved advantages, summarized below, can contribute materially to important savings in the cost of pulverized fuel for large or small steam generators.

Low Power Consumption. Efficient grinding action results in unusually low power requirements per ton of capacity, assuring lower operating costs, year after year.

Low Maintenance. Extremely rugged construction and easy accessibility of all wearing parts reduce down-time for servicing. There are no bearings or lubricated parts subject to dust and heavy pressure. Grinding ring and rollers wear *slowly* and *uniformly* and can be easily replaced when required.

Uniform Product Fineness. Throughout the life of the grinding elements, uniform product fineness is readily maintained without loss of capacity.

Pressurized or Suction Operation. With all moving parts enclosed in a stationary, air-tight casing, the MB Pulverizer can be used for either pressurized or suction operation, providing complete flexibility for various types of firing service.

High Availability. All necessary adjustments for grinding pressure and particle size can be made externally while the mill is in operation, avoiding shutdowns except for periodic inspection or overhaul.

The type MB Pulverizer, with Foster Wheeler feeders, distributors, burners and fans or exhausters, provides a highly efficient and economical pulverized fuel system, supplementing the FW line of heavy-duty Ball Mill systems. For complete information, send for Bulletin MB-58-1. *Foster Wheeler Corporation, 666 Fifth Ave., New York 19, New York.*

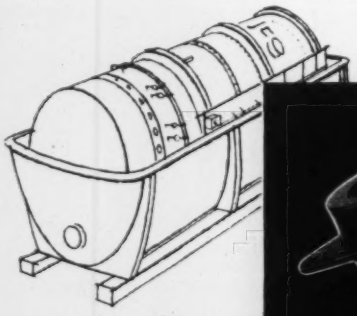
FOSTER WHEELER

NEW YORK • LONDON • PARIS • ST. CATHARINES, ONT.

Have you vibration control problems like this?

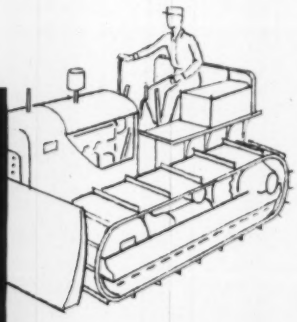
☐ **SOFTEN TRANSPORTATION SHOCK**

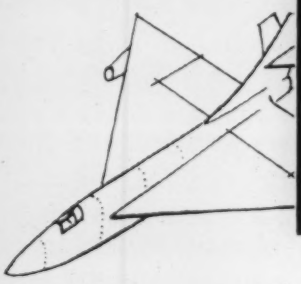
MB Type 1812D83 mounts protect engines in shipping cans. Even for a 3-ft. drop, they restrain displacement and maximum "g" to which engine could be subjected. They also provide a natural frequency to the mass that avoids resonance and amplified vibration in transit.

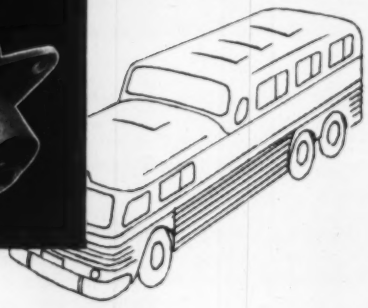


☐ **ISOLATE RUGGED RIGS**

MB Type 5 mounts stand up and successfully isolate engines of even tractor dozers. The tough service conditions prove the efficiency of this original mount designed with equal spring rate in all directions, and with ability to snub damaging overloads.







☐ **CONTROL OVER FULL FREQUENCY RANGE**

MB ISO-DAMP* mounts do what a conventional isolator cannot. They isolate at both low and high frequencies. Protecting the precision of airborne sighting mechanisms, they not only have the required softness, but also a damping mechanism that restricts resonant build-up to under 3.5 to 1 in any direction. *T.M.

☐ **MORE MOUNT MILEAGE**

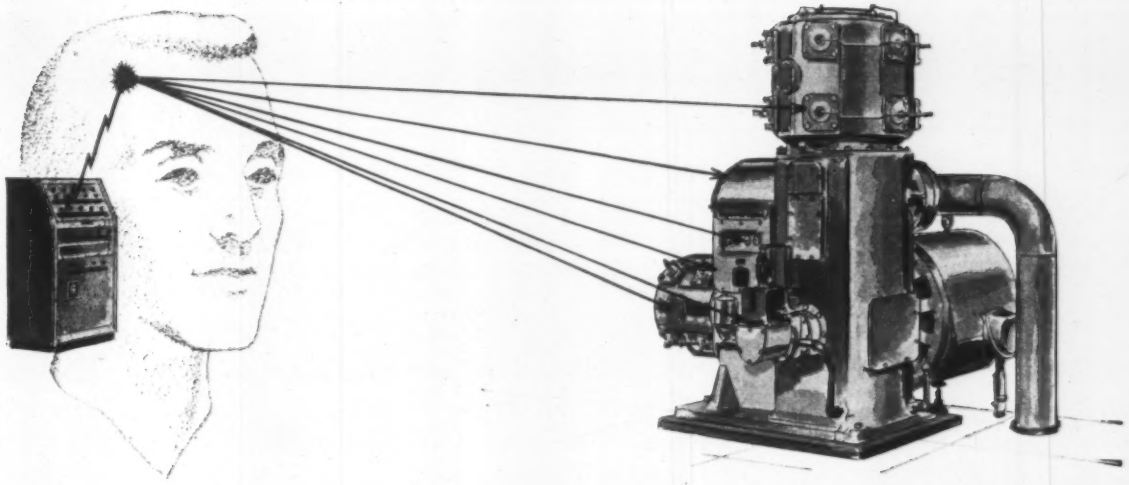
MB ISOMODE® mounts break endurance records. Despite heat, road shock and hard operating conditions in bus service, engine mounts removed for critical inspection after 132,000 miles were still good. To such durability add the superior vibration isolation afforded by a mount that controls vibratory motion in all directions.

MB concentrates on standard mounts which are actually in the special performance class. If you have a problem, avail yourself of our 20 years of experience. Send for Bulletin 616A which tells more.

MB manufacturing company **1074 State Street New Haven 11, Conn.**

A Division of Textron Inc.

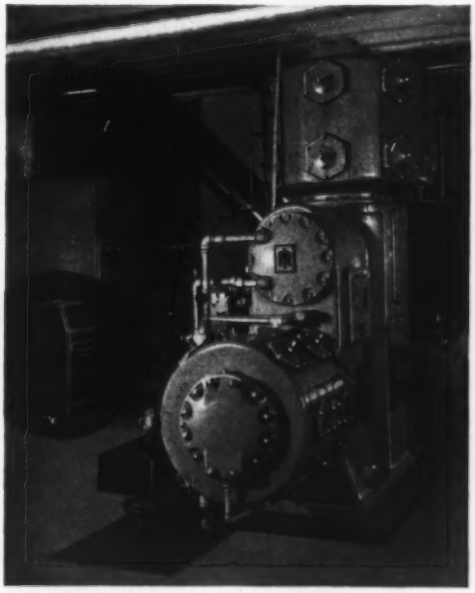
HEADQUARTERS FOR PRODUCTS TO ISOLATE VIBRATION...TO EXCITE IT...TO MEASURE IT.



Making a Compressor "Think for Itself"

New 'Tendamatic control brings automatic supervision to the COMPRESSOR PLANT

the tireless attendant



'Tendamatic control of this Ingersoll-Rand type XLE two-stage heavy-duty air compressor assures maximum protection of capital investment, maximum manpower utilization, continuity of production and lower maintenance expense.

INGERSOLL-RAND's new *'Tendamatic* control is like a *tireless attendant,* who keeps checking the operation of your compressor every second.

All you need to do is push the start button; the 'Tendamatic does everything from then on. Its built-in safeguards eliminate routine inspection and supervision, detect trouble before it can do any harm to the compressor, and put all maintenance on a low-cost *preventive* basis.

This completely automatic control system keeps an eye on air pressure and temperatures . . . lubricating oil pressure and temperature . . . the cylinder lubricator . . . and the float level in the condensate trap. It watches for leaking valves and mechanical failure of running parts.

Any time there is a variation from normal operation, the 'Tendamatic identifies the nature of the malfunction and gives audible *and* visible warnings. If the warnings are ignored or forgotten, 'Tendamatic shuts down the compressor before any damage can result.

To plan now for future savings, ask your Ingersoll-Rand representative for complete information on the new 'Tendamatic compressor control.

'Tendamatic control is available only on Ingersoll-Rand air and gas compressors

Ingersoll-Rand

11 Broadway, New York 4, N. Y.

1-873

GAS & DIESEL ENGINES • PUMPS • AIR & ELECTRIC TOOLS • CONDENSERS • VACUUM EQUIPMENT • ROCK DRILLS

For Rolls... Specify

Versatile ACIPCO *CENTRIFUGALLY SPUN* STEEL TUBES

BLAW-KNOX

Among the equipment Blaw-Knox Company manufactures for many industries are steel mill roll-out tables. ACIPCO tubes, furnished as cast, 12.43″ OD x 9.50″ ID, machine cut to 4-ft. lengths, are used as rolls in this Blaw-Knox table.

Because they are centrifugally spun, ACIPCO tubes are dimensionally stable and possess an inherent high degree of dynamic balance. Their dense, homogeneous, inclusion-free grain structure results in good machinability. In addition, ACIPCO tubes are highly resistant to impact, an important requirement for steel mill table rolls.

These advantages, plus the flexibility of ACIPCO's complete "one source—from start to finish" facilities, are reasons why Blaw-Knox specified ACIPCO centrifugally spun tubes for this application.

"Custom-spun" in stainless steel, all carbon steels or special analyses as well as in all alloy irons including Ductile, ACIPCO tubes are furnished to your exact physical, chemical and metallurgical specifications.

If rolls are a part of your products, or if you use tubular metal components in any way, get full information about ACIPCO. Call or write today.

One of the world's leading producers of complete mills and auxiliary equipment for rolling ferrous and nonferrous metals, Blaw-Knox Company also is a major supplier to the chemical, petroleum, food processing, construction and communications industries. The company has its headquarters in Pittsburgh, and manufacturing plants in Pittsburgh and Erie, Pa., Buffalo, Chicago, Mora, Minn., and Wheeling, W. Va.

VERSATILE ACIPCO TUBES

Size Range: Lengths up to 410″ have been produced to meet modern machinery requirements. OD's from 2.25″ to 50″; wall thicknesses from .25″ to 4″.

Analyses: All alloy grades in steel and cast iron, including heat and corrosion resistant stainless steel, plain carbon steel and special analyses.

Furnished: As cast, rough machined, or finished machined, including honing. Complete welding and machine shop facilities for fabrication.

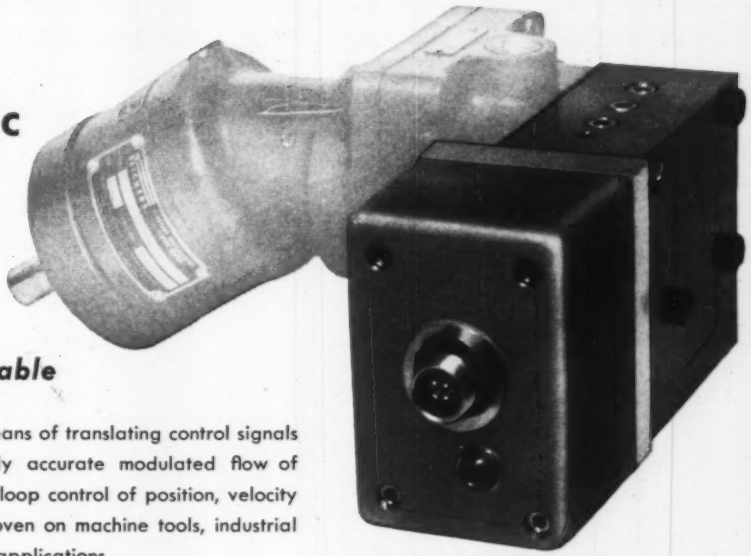
SPECIAL PRODUCTS DIVISION
AMERICAN CAST IRON PIPE CO.
BIRMINGHAM 2, ALABAMA

ACIPCO

New VICKERS® Electro-Hydraulic Servo Valve

has numerous advantages for industrial use:

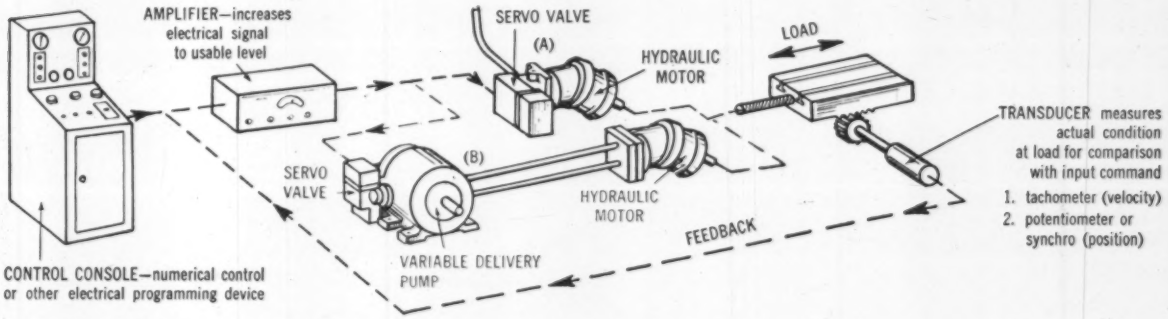
- ***Extremely Accurate***
- ***Simple • Rugged • Dependable***



Vickers Electro-Hydraulic Servo Valve integrated with piston type hydraulic motor provides a minimum amount of oil under compression. Integral cross line relief valves are provided as well as variable cross line orifice for controlling viscose damping. This "package" can provide approximately 20 hp @ 3000 psi and 3600 rpm; variable speed of motor is 0-4400 rpm.

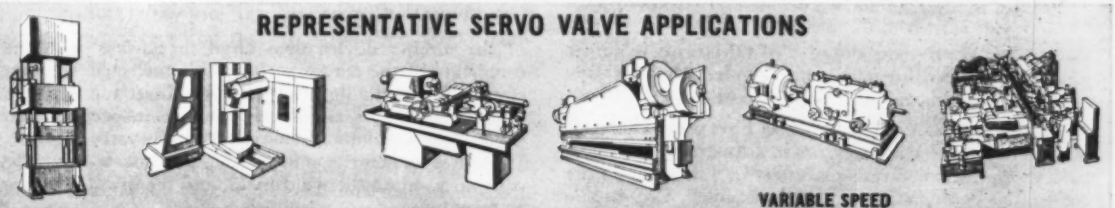
This valve provides a simple, dependable means of translating control signals from electronic programming into extremely accurate modulated flow of hydraulic power for fast and precise closed loop control of position, velocity and acceleration. Performance has been proven on machine tools, industrial processing equipment and ground ordnance applications.

Simplicity and reliability are exceptional . . . only four moving parts are required. Mechanical feedback linkage with unique variable fulcrum provides optimum flexibility for various conditions of flow, response and pressure. For further information, write for Vickers Engineering Bulletin 58-74.



Now the flexibility of electronic control can easily be applied to versatile hydraulic power. Vickers new industrial electro-hydraulic servo valve is used (A) to directly regulate the oil to an actuator (valve motor system). Shown in blue is an alternate application (B) for higher flows when the valve controls a variable volume pump (servo pump system).

REPRESENTATIVE SERVO VALVE APPLICATIONS



PRESS
Ram velocity controlled accurately during all cycles.

MILLING MACHINE
Precision control of velocity, position and acceleration of slides and tables.

LATHE
Exact feed rate and position control of cutting tool.

PRESS BRAKE
Cylinders synchronized precisely.

VARIABLE SPEED DRIVE
Accurate velocity control of spindle speeds for test stands or machine tools.

PROCESS LINE
Programmed control of Material Handling and machine sequencing.

8126

VICKERS INCORPORATED
DIVISION OF SPERRY RAND CORPORATION
Machinery Hydraulics Division
ADMINISTRATIVE and ENGINEERING CENTER
Department 1500 • Detroit 32, Michigan

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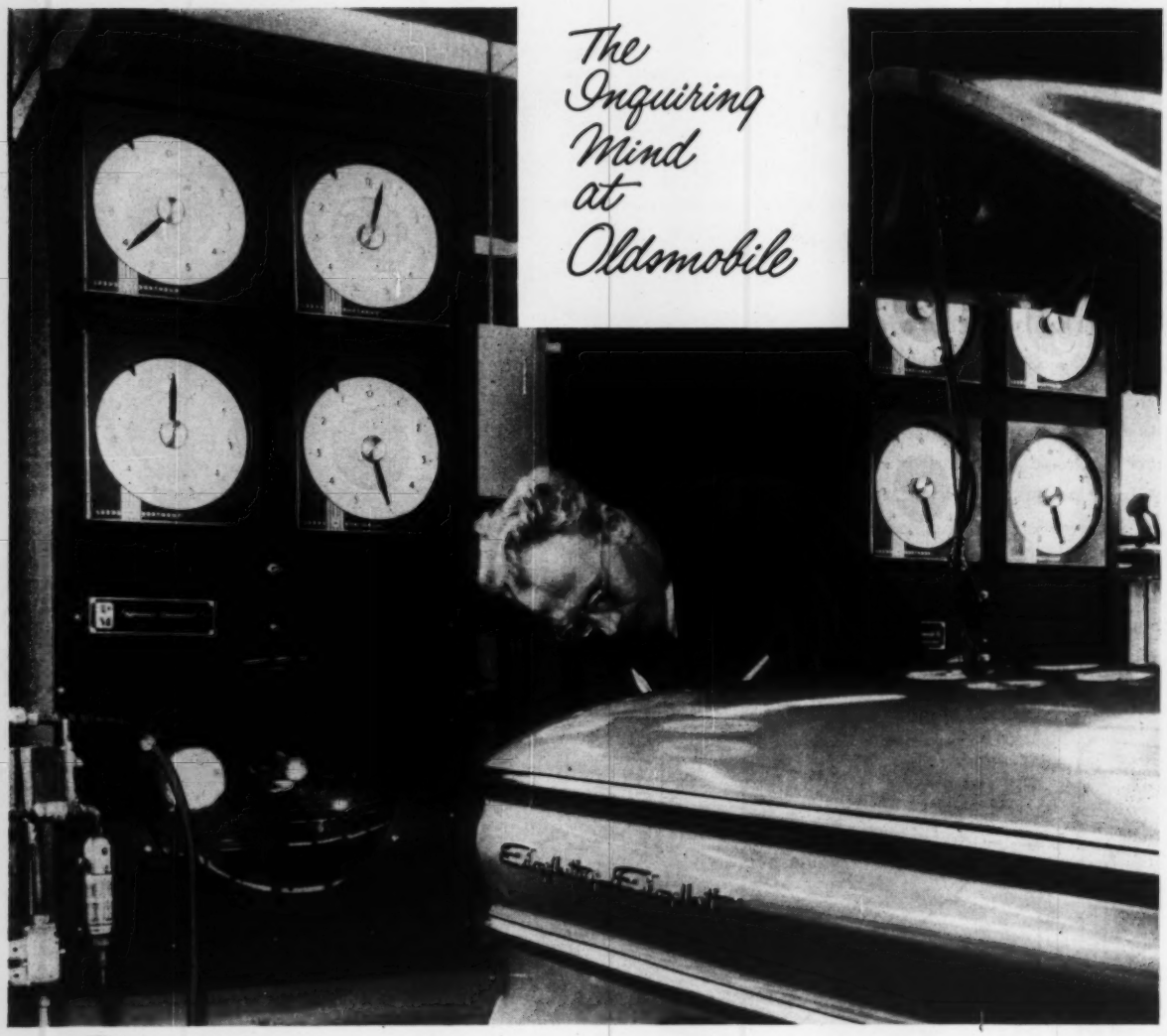
ENGINEERS AND BUILDERS OF OIL HYDRAULIC EQUIPMENT SINCE 1921



The Inquiring Mind at Oldsmobile

no. 5 OF A SERIES

LIGHTING YOUR WAY TO A SAFER FUTURE

Safeguarding lives is the aim of Oldsmobile's new electronic headlamp aiming device that makes sure every Oldsmobile has perfect "see-ability".

Night driving safety depends upon how precisely headlamps are aimed. Minute errors in adjustment can mean the difference of several square feet in light area on the road. To be completely on the "safe side", Oldsmobile aiming standards specify that lights be aimed *twice* as accurately as required by state laws.

To make certain that every light is aimed perfectly, Oldsmobile engineers developed an ingenious electronic device that effectively measures light intensity and direction, even at Oldsmobile's highest production rate.

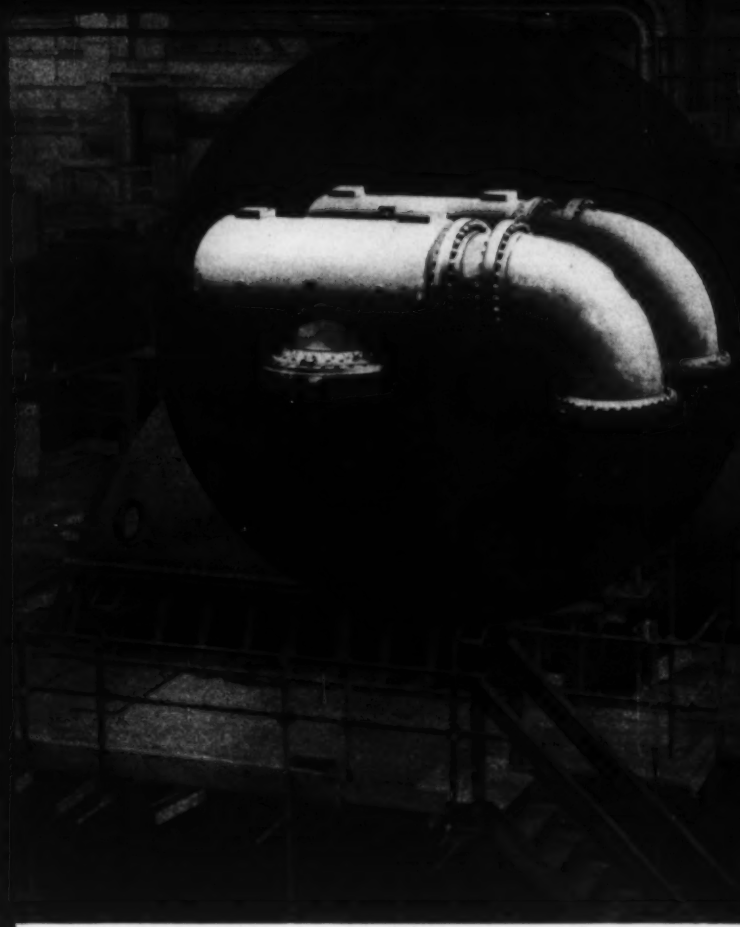
On the assembly line, every car is automatically shuttled to the aiming platform where two probes rise out of the floor and "feel" the exact location of the car. The "eyes" of the aiming device then align themselves with the centerline of the car. A series of photoelectric cells instantly record the light intensity and direction on large dials. A built-in scanning circuit then inspects all settings of the headlamps to make certain they are accurate. If there is an error, a colored soap solution is automatically sprayed on the windshield, and the headlamps are re-aimed.

Oldsmobile takes pride in producing an automobile as advanced in every respect as modern technology can make it. However, you owe it to yourself to have your headlamps periodically checked. As part of General Motors' public-spirited "Aim to Live" program, your Oldsmobile Dealer is featuring headlamp aiming, as well as other important safety services for you. Stop in soon . . . and while you are there, take a test drive in a new Olds—sales leader of the medium price class.

OLDSMOBILE DIVISION, GENERAL MOTORS CORP.

OLDSMOBILE

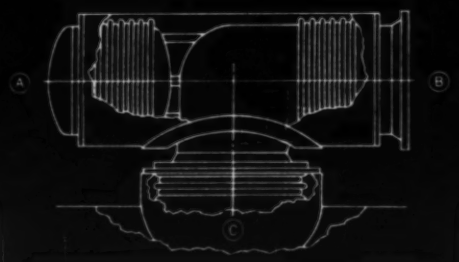
Pioneer in Progressive Engineering ... Famous for Quality Manufacturing



GIANT Turbine Expansion Joints Built by BADGER

Photo shows 150,000 kw steam turbine-generator unit undergoing tests prior to shipment at General Electric's Turbine-Generator Plant in Schenectady, N. Y. Badger Expansion Assembly is clearly visible atop turbine.

Badger balanced elbow expansion assembly.



Joint A balances thrust due to internal pressure of 65-150 psi; joint B absorbs axial movement; joint C absorbs the differential expansion between the inner and outer casings of the turbine. Assemblies range in size from 36 to 42 inches in diameter.

Custom engineered assemblies include many features of Badger S-R Design

750°F steam is flashed through these turbine crossovers at speeds up to 150 ft/sec and pressures up to 150 psi.

How do you protect piping and turbine casings from the stresses of extreme internal pressure and the expansion such temperature is bound to produce?

Working together, Badger and engineers at General Electric's Large Steam Turbine-Generator Department solved the problem with a new type pressure balanced elbow expansion assembly. Using two separate joints mounted in a T-shape casing (see diagram) the assembly effectively absorbs and controls axial movement. Although the device was custom engineered to General Electric's requirements, the bellows elements are constructed to the Curvilinear Corrugation design recently announced by Badger and now used in all S-R Expansion Joints.

Whether you need standard S-R Expansion Joints or custom equipment, Badger can serve your needs. Get more information — write for illustrated brochure today.

New corrugation and ring designs produce better equalization, "all-curve" flexing

Curvilinear Corrugations used in S-R Expansion Joints were developed by the Badger Research Department. Under operating pressures (white line) the new design produces more uniform movement per corrugation and natural "all-curve" flexing. Stress is reduced... life increased.

Series 50 corrugation cross-section

S-R Joints for higher pressures have tubular Reinforcing Rings. These new rings make metal-to-metal contact only in the "valley" of each corrugation allowing natural "all-curve" flexing (white line). Tubular shape permits greater effective flexing height which contributes to longer life.

Series 150 corrugation and ring cross-section

BADGER

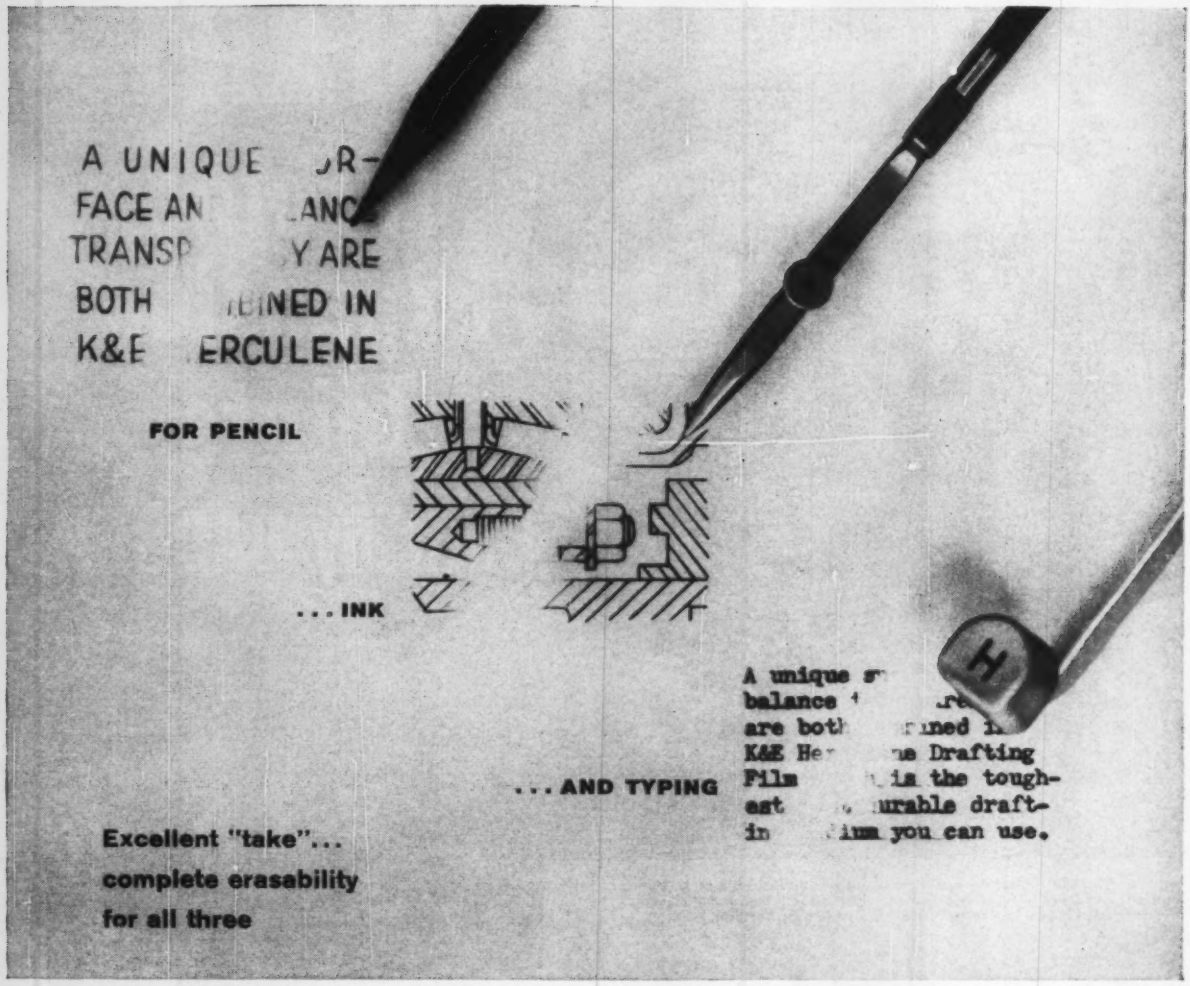
S R

SERVICE RATED

EXPANSION JOINTS

© 1958 BMC

BADGER MANUFACTURING COMPANY
230 Bent St., Cambridge 41, Mass. • 60 East 42nd St., New York, New York
Representatives in Principal Cities



Now K&E provides the ultimate "3-way" surface for super-tough HERCULENE™ Drafting Film

Only K&E Herculene Drafting Film has a surface perfectly engineered for pencil, ink and typing . . . plus the extreme toughness and durability of a DuPont "Mylar®" film base. You get the absolute assurance of superior "take". And Herculene erases easily and quickly without the need for erasing or correcting fluids.

Virtually indestructible, Herculene is so tough you can hardly tear it. It can't be damaged by moisture. And it's permanent . . . your drawings are resistant to damage by aging or handling.

Herculene has "balanced" transparency . . . just the right combination of high actinic transparency for reproduction with essential visual opacity for drafting. You get sharp, legible reproductions at high machine speeds. And you can make prints from a Herculene Drawing indefinitely without its yellowing or tearing, cracking or becoming brittle.

Herculene is economical too . . . costs only a few cents more than cloth. Prove these facts for yourself by writing today for a free sample. Just clip and mail the coupon below.

KEUFFEL & ESSER CO., Dept. ME-9, Hoboken, N. J.

I want to see a sample of the new K&E Herculene.

Name & Title: _____

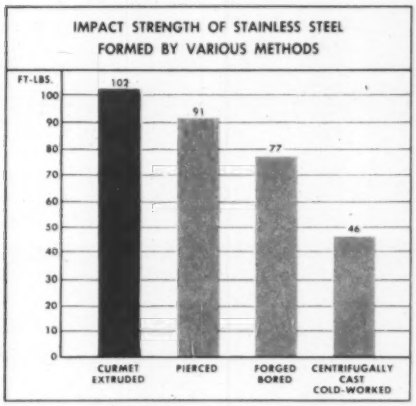
Company & Address: _____

_____

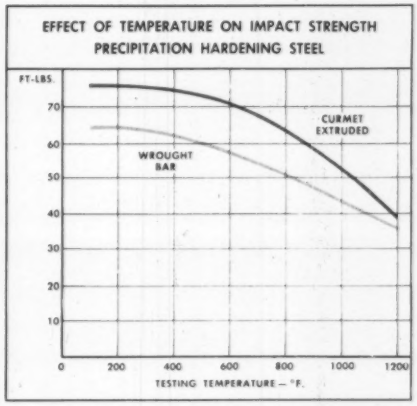
EXTRUSION • CASTING • FORGING • FABRICATION

CURMET

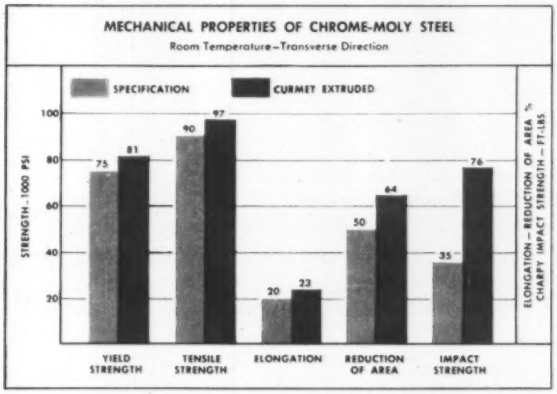
For Superior Resistance to **IMPACT** *Stresses*



Impact strengths (Charpy) at 300° F. below zero. Curmet extruded Grade 304 stainless steel shows strength from 13% to 120% higher than the same alloy processed by other methods. Improvement in impact strength is consistent up to 1200° F.



Impact resistance of strength-at-high-temperature steels (A-286 in this case) is substantially greater when Curmet processed. The Curmet extrusion tests consistently 10 ft.-lbs. better than the usual wrought product.



"Above specification" characterizes the physical properties of all Curmet products. But impact strength is particularly noteworthy—more than 100% over specification—as shown by these test results on heat treated Grade P-22 steel.

Curmet Processing Adds to Alloy Performance

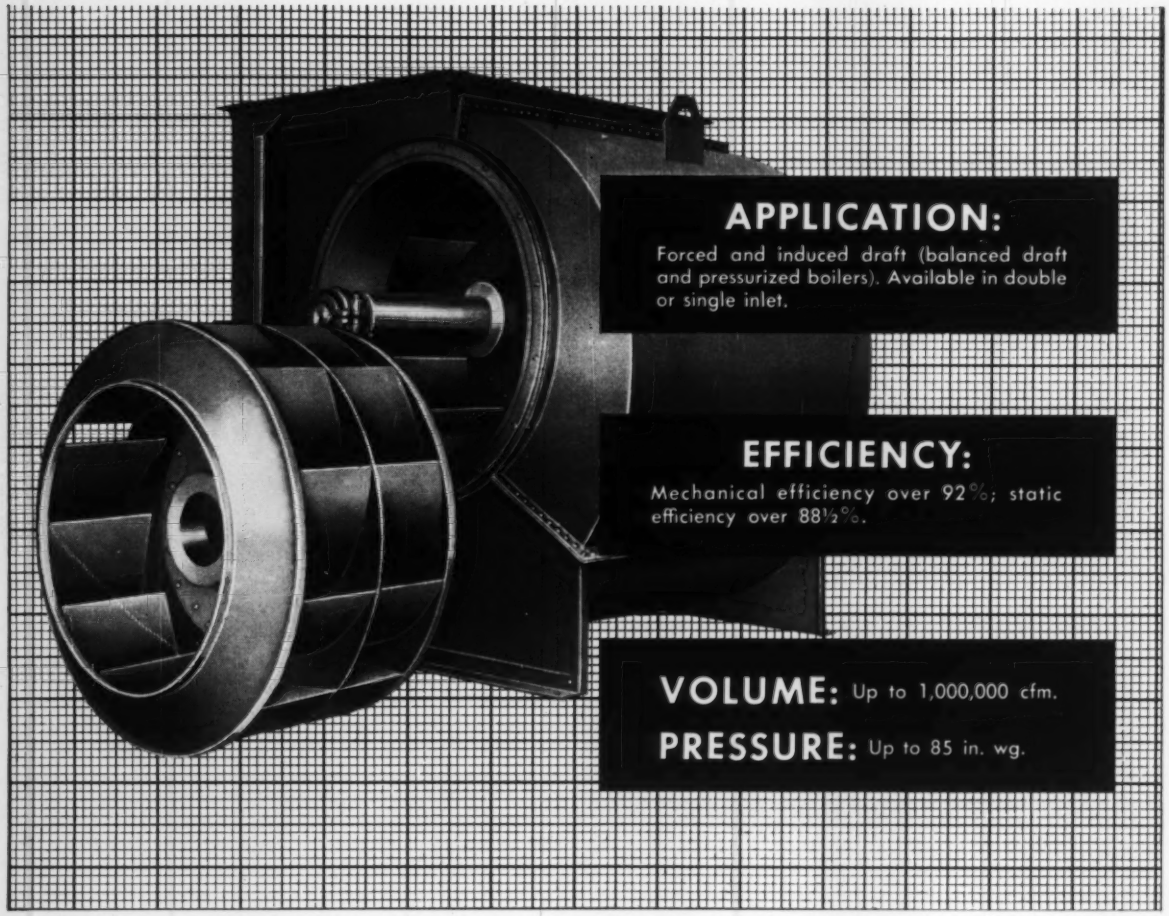
This is one of many outstanding achievements in metals from the Curmet plants and laboratories. As the frontiers of metallurgy advance under the pressure of more critical operating conditions, Curmet processing utilizes skills and knowledge, based creatively on wide experience with high performance metals, to give added integrity to new alloys.

FOR FULL INFORMATION, WRITE TO:

METALS PROCESSING DIVISION
760 Northland Avenue

CURTISS-WRIGHT CORPORATION
Buffalo 15, New York

AMERICAN BLOWER AIRFOIL FANS


APPLICATION:
Forced and induced draft (balanced draft and pressurized boilers). Available in double or single inlet.
EFFICIENCY:
Mechanical efficiency over 92%; static efficiency over 88½%.
VOLUME: Up to 1,000,000 cfm.
PRESSURE: Up to 85 in. wg.

If you're thinking "airfoil" on your next mechanical-draft installation, think of American Blower.

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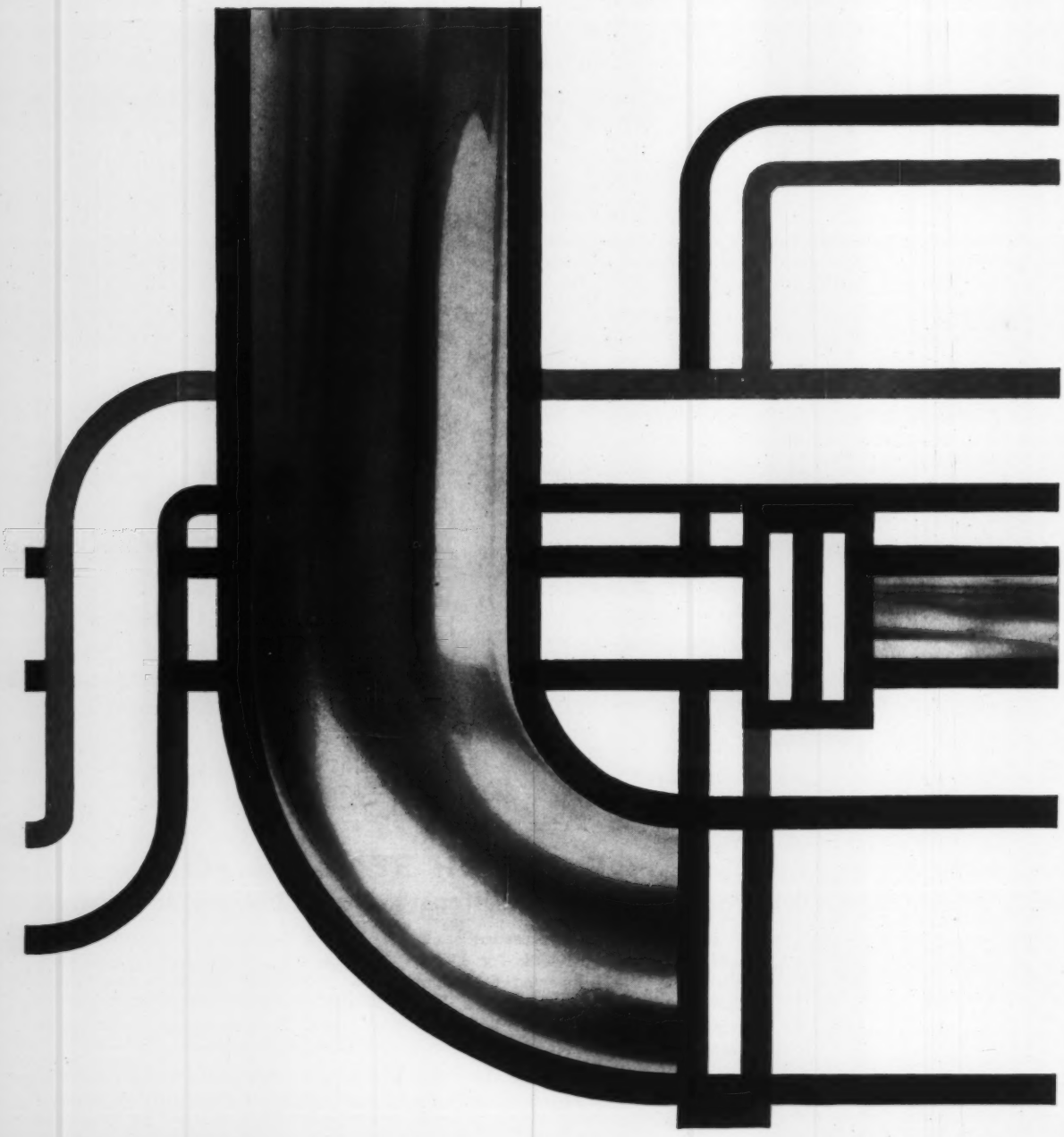

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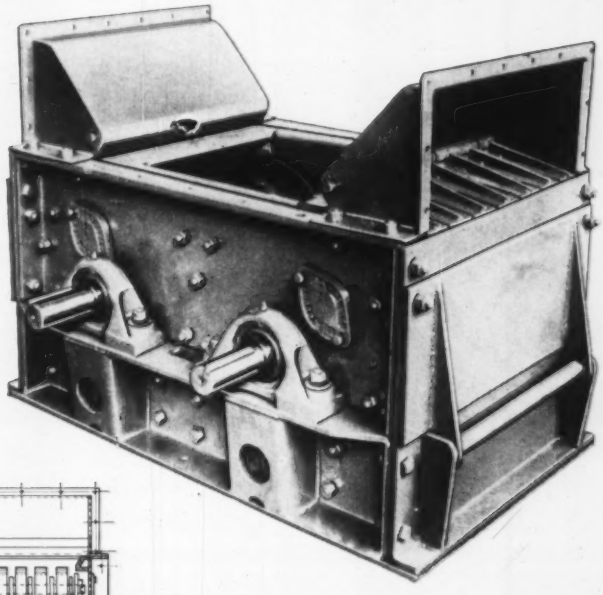

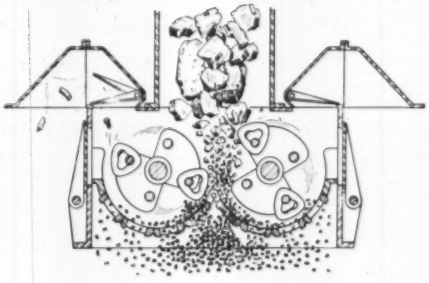

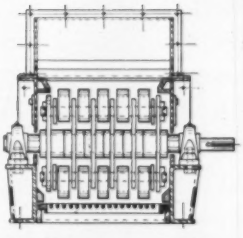

S-A Knittel crusher is provided with tramp iron release fingers. Service and inspection doors are located at either end. Rotor shafts turn on Sealmaster Ball Bearings.

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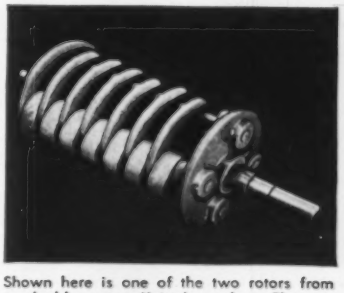
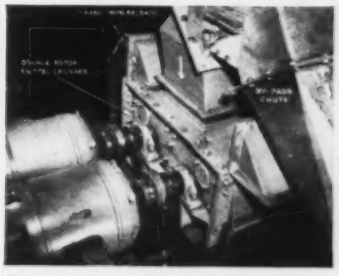
A pioneer designer and manufacturer of conveying equipment for over half a century, STEPHENS-ADAMSON has created many of the world's finest coal handling systems. Whether you need a single conveyor product, or a fully engineered system, there's a member of the S-A sales engineer team in your area He is eminently qualified to advise you. For complete catalog data on Knittel crushers, write for our bulletin 2-C.

S-A district or main plant offices can supply complete information on any conveyor product or any phase of coal handling. Just write or call.



Shown here is one of the two rotors from a double rotor Knittel crusher. The triangular sectors in each rotor assembly rotate toward each other at speeds up to 1150 R.P.M. Up to 1275 T.P.H. of bituminous coal can be handled in standard Knittel crusher sizes.



This double rotor type Knittel crusher installation sizes coal for an industrial power plant. Lumps are split and fragments are fed thru sizing grates beneath the twin rotors. Coal is then carried away by belt conveyor to outside storage or to boiler house bunkers.

Some of the 150 Foxboro Dynalog Recorders used at Rocketdyne's Propulsion Field Laboratory. During each test, these instruments log critical items of information with split-second timing and exacting accuracy.

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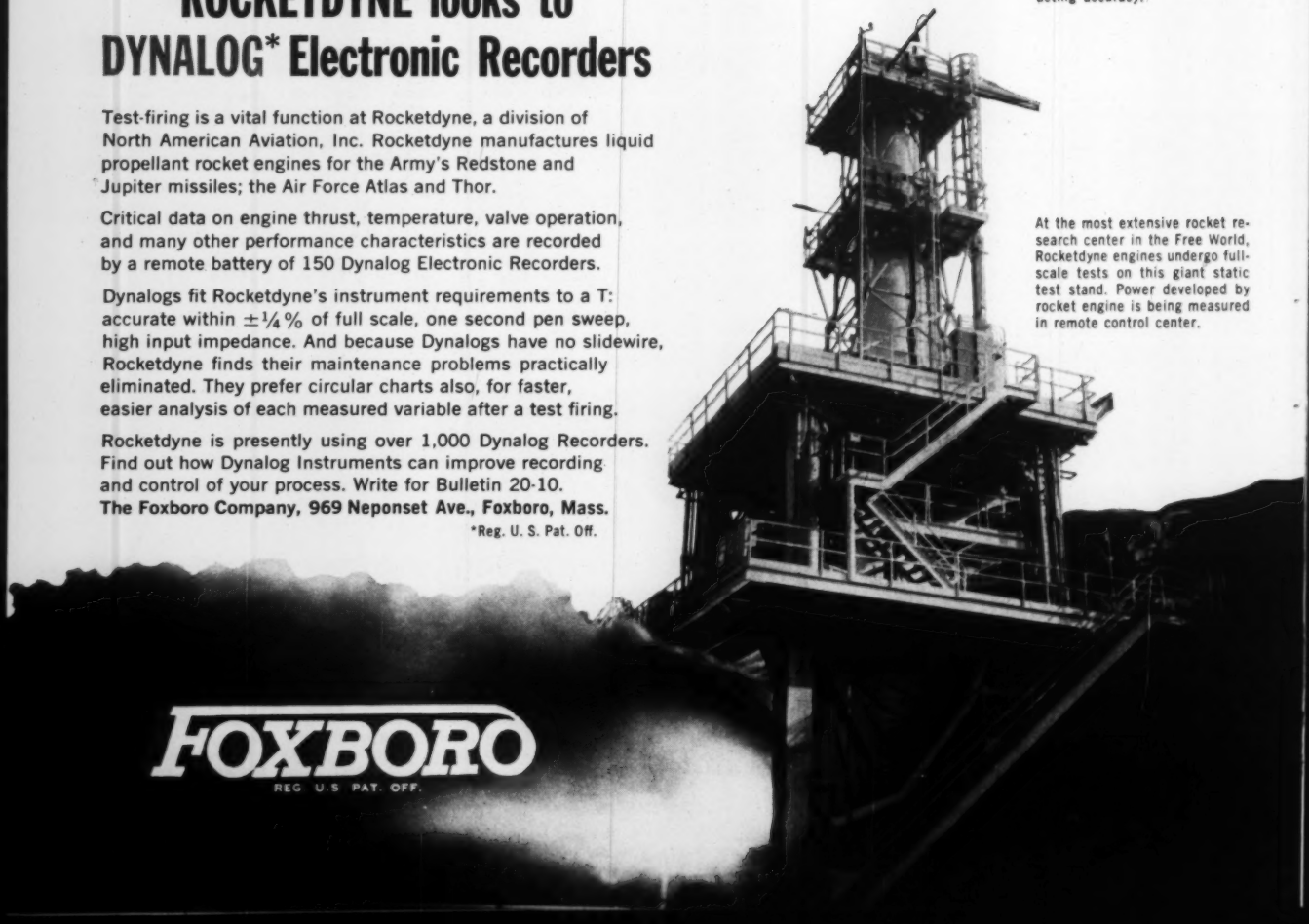

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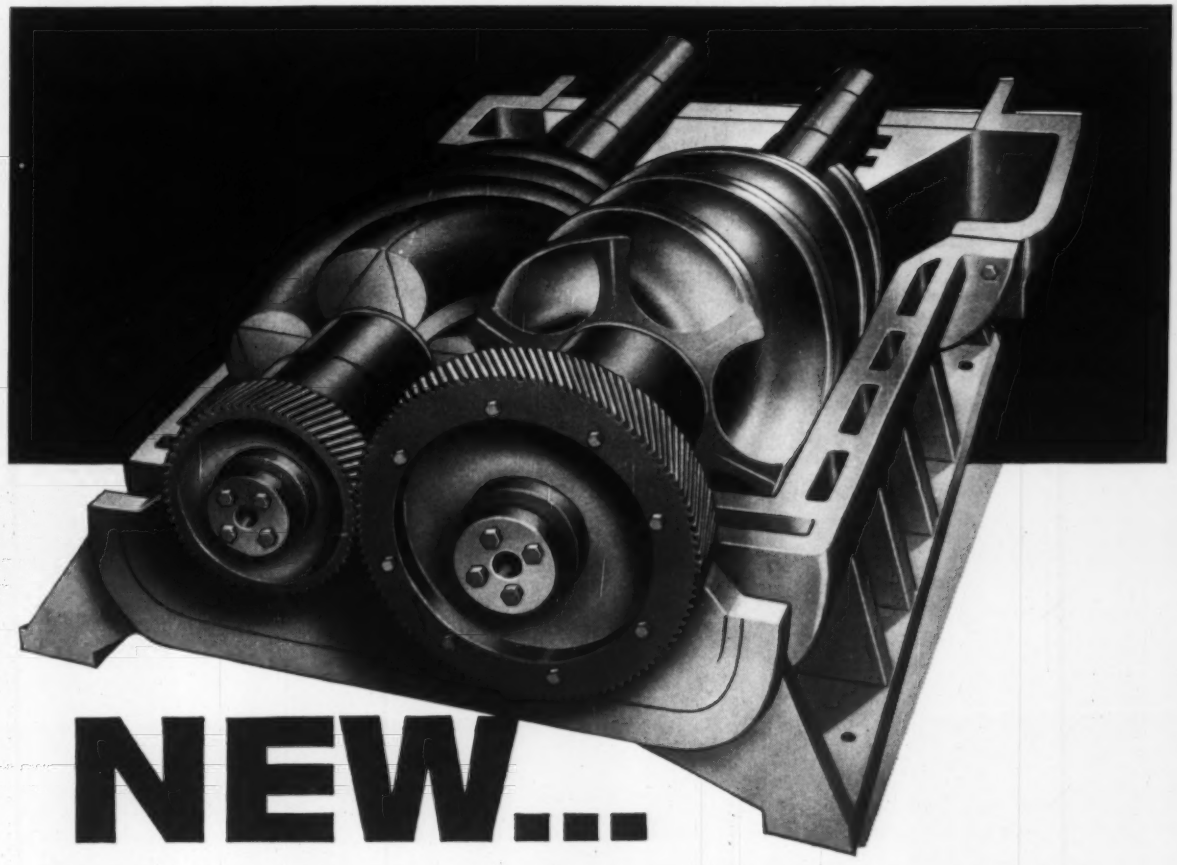

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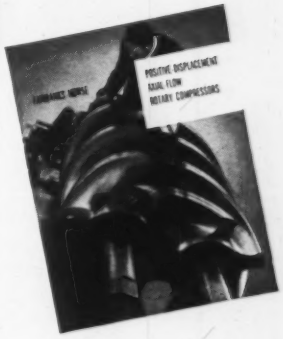

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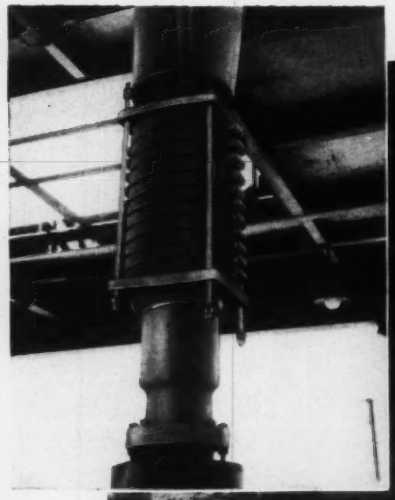
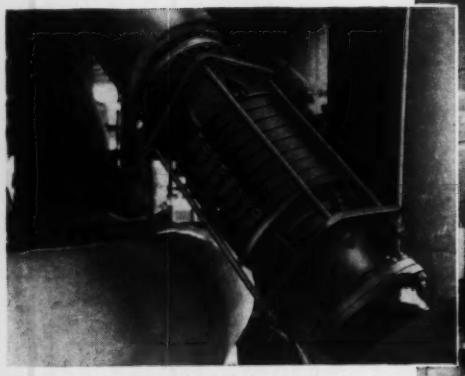
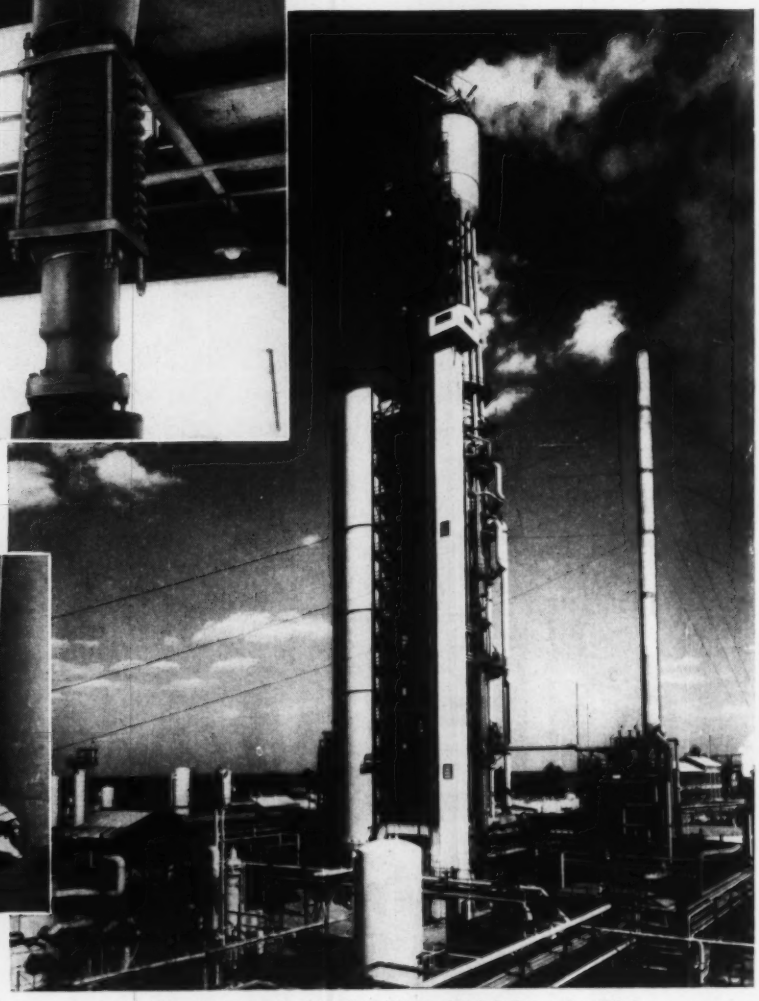


ADSCO Corruflex Expansion Joint with #316 stainless steel element. From the position of the tie-rods, note the pipe movement the joint is absorbing.



In this section of the Houdriflow unit, there are 12 ADSCO Corruflex Expansion Joints with #316 stainless steel elements. Temperature here is 1100°F.



Houdriflow Catalytic Cracking Unit, Marcus Hook Refinery, Sun Oil Co.

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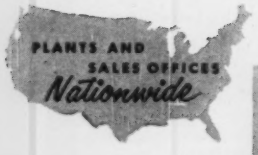

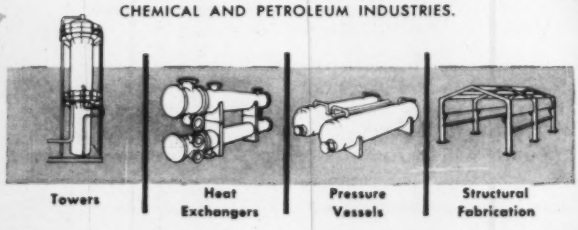

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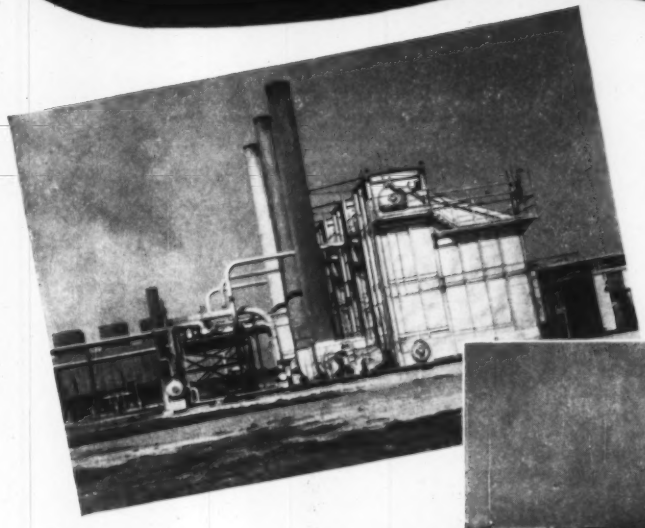
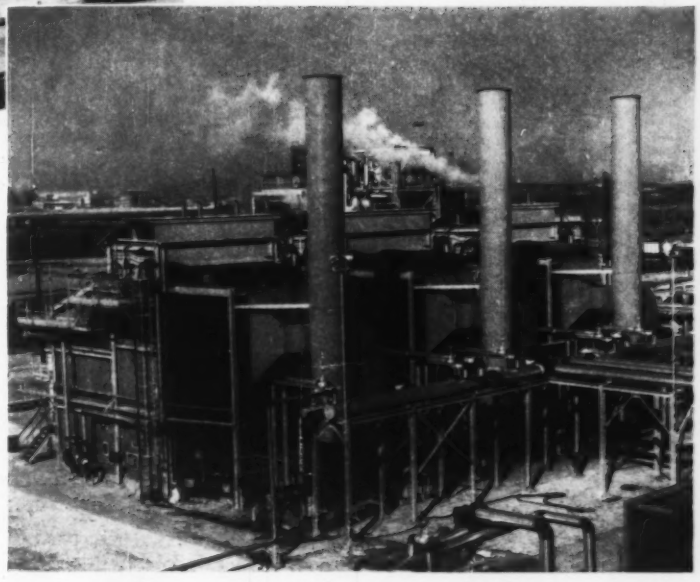


Three 85,000 #/hr. steam generators in a Texas refinery.



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MECHANICAL ENGINEERING

VOLUME 80 • NUMBER 9 • SEPTEMBER, 1958

They're Hiring Graduates!

In spite of the adverse economic climate which prevailed at the time, job opportunities for the 1958 class of engineering graduates reflected a remarkable degree of stability. This was revealed in a survey made by the Engineering Manpower Commission of Engineers Joint Council, during May, 1958.

Not so long ago, in 1952, many engineering leaders attending the annual meeting of Engineers' Council for Professional Development, in Chicago, agreed with E. G. Bailey, past-president and Hon. Mem. ASME, when he urged that engineering graduates be taken on "every year whether business is good or bad. One of the mistakes which many companies have made is to take on fewer graduates when times are a little slack. . . We all shortchanged the engineering graduates during the depression of the thirties and then we needed them very much during the war."

Is it possible that industrial establishments doing the hiring have learned from bitter experience that it is necessary to employ young engineers regardless of the economic situation?

It would seem so, for the survey reveals the following noteworthy facts: Nearly 79 per cent of the engineering graduates had firm commitments by May 20, 11 per cent were considering offers, and only about 10 per cent did not have immediate employment offers or were otherwise uncommitted—although these still had close to a month to develop plans.

For purposes of comparisons, the colleges were also asked to provide equivalent information for graduates in other fields. Although these data were limited, the information indicated that physical science graduates were in as great demand as engineers. However, graduates from business administration and general liberal-arts courses did not fare as well, with 25 per cent and 30 per cent, respectively, uncommitted by May 20th.

The survey was conducted like this: During the second week of May, a mail canvass was made of the deans of engineering of 159 colleges with curriculums accredited by the Engineers' Council for Professional Development plus 53 other bachelor-degree awarding schools. The deans were requested to provide placement information as of May 20.

Participants were asked to reply by June 1, but returns were accepted up to June 10. By the cutoff date replies had been received from 115 accredited colleges and from 31 nonaccredited institutions.

Tabulations for the survey, however, were based on 104 returns from accredited institutions and 28 others since the remainder provided only partial information or were otherwise unusable. Nevertheless, the responding group represents a significant proportion of the 1958 engineering graduates (15,591 or about 45 per cent) and included institutions of every kind, size, and geographic location.

Although no follow-up was made to determine what changes took place in the reported situation following graduation, a few late returns received after June 20 indicated that 83.5 per cent of the engineering graduates were employed, 8 per cent entered graduate studies, 7.5 per cent entered the military services, 1 per cent were considering offers of jobs, and none was without job offers.

Thus it is apparant that the need—at least for recent engineering graduates—is still urgent. This is as it should be, for a solid engineering foundation is extremely vital to the United States if we are to continue to hold our constantly threatened technological leadership.—*J. J. Jaklitsch, Jr.*

Editor, J. J. JAKLITSCH, JR.

Editor Emeritus, GEORGE A. STETSON

ENGINEERS IN MANAGEMENT?

By H. W. Johnson[1]
Massachusetts Institute of Technology, Cambridge, Mass.

The "typical engineer" discovers he is not highly rated as management material. What can he do to broaden his understanding of his company?

To the question, "Do engineers make good managers?" one is tempted to answer by citing the great examples. There is Alfred P. Sloan, Jr., perhaps the most important single figure in the development of modern corporate management. One thinks of George Washington Goethals, the engineer who made the Panama Canal a reality in the face of fantastic problems. There are the Wilsons, the Killians, and so on.

And yet the great examples prove no point except that it is possible for an engineer to move to the top management posts. A gnawing doubt remains. When people say, "He's a typical engineer," they usually are not paying tribute to his great managerial ability.

The Manager's Job

The manager-executive must somehow integrate the resources of the organization—technical and human, financial and organizational—to reach the organization's goals. He does this by taking responsibility for:

1 Setting the objectives, complete with plans and timetable.

2 Organizing the resources to achieve the goals—and this involves direction and control.

3 Finally, evaluating his progress and learning from his mistakes.

At each stage, the road is strewn with decisions to be made, and this is where management takes on its dynamics. The situation changes externally and internally. New plans must be developed, old plans revised, strategies changed. The level of the executive's job determines the scope and nature of the decisions. The quality of his decisions in the midst of a more or less moving stream of data determines the quality of management.

At top executive levels, the manager must grasp the total relevance of all parts of the business process, seeing everything in proper balance. When the decision was made to complete Project Vanguard on its original timetable, who could have known that the Soviet's sputnik would have been such a propaganda success in the uncommitted and underdeveloped parts of the world? Yet this was a relevant consideration in the whole equation.

When experienced managers are asked, "What areas of deficiency do you note most frequently in rising managers?" the answer almost always mentions finance and human relations. These men are not saying the technical side is unimportant. But beyond the engineering and production problems there lies another whole range of integrating decisions.

At middle management levels we are in an era where no one manages without the consent of his subordinates. The engineer-scientist frequently learns this the hard way. There is the example of the technician in a research laboratory who complained that his chemical-engineer boss was still calling him by the name of his predecessor of six months—this despite frequent corrections and protests. The subordinate was simply being treated as another machine in the pilot-plant process.

There are many other examples of the middle manager who doesn't see the whole picture—the department head who understands the cost problem with relation to his own budget, but not beyond it; the department head who resents the staff help offered him. This is not a matter of techniques and gimmicks. It has to do with a basic "feel" for the total picture.

Who's More Important?

These failings are deficiencies only if you choose to call them so. The engineer who remains an engineer because he wants to is acting in the best of tradition. Indeed, many companies have sought ways to provide compensation and status to keep him from answering the siren call of administration. They are concerned with the so-called shortage of engineers.

The shortage of good managers is more real than any other. Those who have the basic characteristics for this calling are relatively rare and should be utilized in these roles. The concern, here, is with the engineer who could become a good manager and will not. The question is: Why doesn't the engineer develop as an effective manager?

There are two kinds of answers. First, the management-potential engineer may see himself solely as an engineer. He sees the attendant problem of management as being irrelevant. He views the human problems of the managerial process as too frustrating.

Second, there is the engineer who is nominally functioning in a manager's role but who excludes nonengineering and nontechnical considerations from his concern.

It is important to recognize these people—the ones with the potential and energy who have the qualities of integrity and courage that the good manager has. Then, the potential manager must be provided opportunities to gain the breadth that higher managerial jobs require.

The Broadening Experience

A chance at new work is probably the most important

[1] Associate Professor of Industrial Management and Director of Executive Development Programs, School of Management.

Contributed by the Management Division and presented at the Joint Engineering Management Conference, Boston, Mass., March 19–20, 1958, of The American Society of Mechanical Engineers and the American Institute of Electrical Engineers. Condensed from ASME Paper No. 58—MGT-5, "The Development of Engineering Personnel for Management Responsibility."

single source of growth in most people's lives. By this is meant a new assignment, requiring a maximal effort in new directions. Some years ago, a study at International Harvester pointed up that every member of a key group of executives recalled a "break"—a heavy and unexpected assignment requiring ingenuity and great effort—that had been prominent in pushing him up the ladder.

The rotation principle can be an excellent vehicle in the achievement of this kind of task experience. It must be bolstered by review, and the review process should call attention to the areas of new content in each job. Any conscious effort to drop the new areas of responsibility should be noted and weighed. Ten years ago the case was reported[2] of the director who said, "I wish we could hire someone to take these personnel problems off my hands . . . An expert could do a far better job than we are doing and leave us free to get on with our work." It is likely that this man has gone through several experts by this time, still has human-relations problems, and is still trying to get on with his work.

Why Isn't Everyone Just Like Me?

The intellectual contact with new co-workers is an effective stimulus for the man who seeks to grow. Unfortunately, the engineer, like everyone else, is more comfortable with people of his own frame of reference. He needs personality intermix. Short courses at the American Management Association, or in the local university, are good bases for this purpose. The jolt of discovering that others do not even speak one's language can be refreshing or terrifying. Or it can produce nothing at all but a condescending nod toward the unenlightened. The latter is the most neutral response, and is perhaps the route frequently followed by the engineer.

There is a great hunger on the part of engineer-trained personnel for nonengineering material. Executive development groups at M.I.T. find study, reflection, and discussion of economics, law, political science, psychology, and humanities an invigorating pursuit. It involves a setting and a pace. Perhaps that is why more isn't done. Reading Machiavelli's "The Prince" is only a literary experience, and an unlikely one at that, unless it becomes the base for a discussion with one's peers of "Do the ends justify the means?" and "Is 'fear' more effective than 'love' in the control of subordinates?"

Actually, every man's pioneering for new habits is painful. Yet, once achieved, it almost always produces new insights. If the engineer can somehow build reading and reflection into his life, new avenues of growth open up.

New situations can help. A visit to another plant can merely be a walk past another phalanx of automatic screw machines, or it can be an opportunity for seeing new interpretations of productive resources. It takes self-discipline and self-appraisal to get the most from such situations.

Personal Involvement

These opportunities are only opportunities, not sureties. The prerequisite for their effective utilization is the individual's interest in this process for himself. If there is no involvement on the part of the individual, no awareness of the opportunity, it will pass unused. If it is used, the fertile, active mind will be stimulated toward development of the innovative approach so important to effective management.

Two problem sources are apparent. One is *perception*. The engineer, like everyone else, "sees" things in a limited framework. Often specialization produces a narrow range of perceiving the so-called "facts" of a situation. He refuses to "see" areas of management beyond these "facts." Or he refuses to accept responsibility for those things that are "beyond" his control.

The other is *assumption*. What one perceives is obviously affected by the way in which we assume things work. The engineer has a strike on him if he assumes too readily, for example, that groups and individuals are less important than other variables, or that financial management is something for the accountants to worry about. To assume away the basis of any part of the managerial process limits the effectiveness of the manager in integrating the resources of the business.

The process of personal growth, vital to a manager's educational experience, relates to widening one's perceptions and cracking one's smug assumptions.

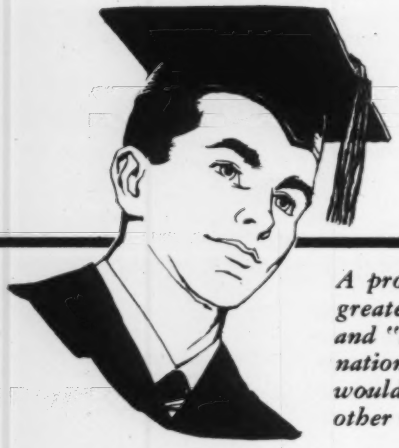
✓	What do executives do?
✓	Is management for me?
✓	What's the executive got?
✓	Why did I miss out?
✓	How do I bridge the gap?

Engineering as Basic Training

We at M.I.T. believe that engineering is excellent basic training for the role of manager. The engineer is superbly equipped to apply the logics of analysis to business data. He is equipped with the tools of the newly developing analysis.

Yet the total problem involves much that is not revealed by the engineering approach. Here is the area of insight and competence the engineer must take on if he is to be an effective manager. Once he has invaded this area, the engineer has an edge in the management ranks that his nontechnical brothers find hard to equal.

[2] D. M. McGregor, "The Staff Function in Human Relations," *Journal of Social Issues*, vol. 4, 1948.



By James C. Zeder, Vice-President of Engineering,

TRAINING FOR

A proposed major revision of engineering curriculums would place greater emphasis on fundamentals and leave much of the specialized and "hardware" training to industry. Traditional departmental designations—mechanical, civil, and electrical engineering, and so forth—would be replaced by three departments: One dealing with energy, another with materials, and a third with man, according to one proposal.

WE ARE living in a time of change. Our products are changing, our research techniques are changing, our methods of manufacturing are changing. The jobs of the engineer are changing, too. And over a period of a few years, a lot of engineering jobs may even cease to exist in anything like their present forms.

This is the kind of world we engineers have to work in—and the kind of world we can expect to work in from now on. In the past quarter of a century the engineer has had to step lively to keep up with the incredibly fast advance of engineering and science. And there's no doubt in anybody's mind that scientific and engineering progress of the future will be made with even greater speed.

The Essential Requirements

Our engineering education is inadequate unless it gives the young engineer the broad knowledge that will enable him to move with the times—to shift from one technical field to another, to take on management responsibilities, and to make important contributions to the whole vital field of public policy in an age that will be profoundly affected by expanding science and technology. We just can't afford to assume that professional specialization alone will be at all adequate in a world which demands ever-increasing flexibility and versatility. As Peter Drucker has said: "A school can do a student no greater disservice than to prepare him for his first job."

The need for engineers with the ability to move with the times was forcefully demonstrated during World War II. Under the impact of war, the scientists and engineers of this country pushed rapidly into new areas of technology. And they ran up against many new problems. Unfortunately, a lot of engineers were not up to the task of solving them.

Too few engineers had the firm base of scientific principle that was necessary to translate new scientific knowledge into useful engineering technique. Too few engineers thoroughly understood the problems, or the solutions to problems, in advanced research. This was especially true in the fields of radar and atomic energy.

The very great contribution that engineers of all kinds made during the war is not being minimized, but how much greater the total contribution of engineering might have been had we recognized in the 1920's and 1930's the engineer's compelling need for a broad background of fundamentals that would permit him to stay abreast of scientific development.

More Engineers in Research

Today, more and more engineers are being called into research, because industry and government are having to dig deeper and deeper to find the answers to their engineering problems. According to the National Science Foundation, in 1920 less than 3 per cent of the engineering graduates in this country went into research and development. Today well over 25 per cent go into research and development. And in some fields of engineering, such as electronics, 90 per cent of the graduates are hired for research jobs.

In many areas of research, the difference between the work of the scientist and the engineer is indistinct. Most of classical physics, for instance, has become an everyday working tool for advanced engineering. And it seems certain that as the physicist explores new fields such as nuclear energy, he will virtually abandon to the engineer the areas of fluid mechanics, electromagnetic fields, heat transfer, thermodynamics, and the properties of metals.

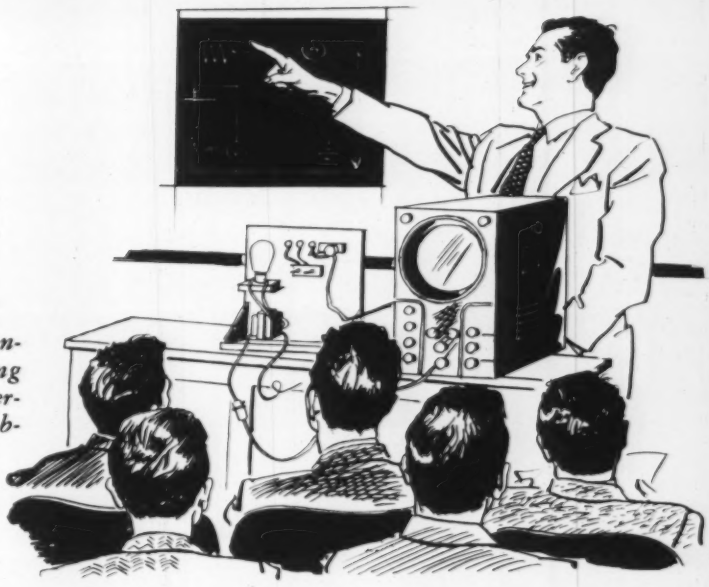
Although the efforts of the scientist and the engineer are moving closer together, they are not the same. The engineer's unique contribution to research is still—and must always be—the practical point of view. It is the engineer who applies scientific principle to a product; who puts scientific discovery to work for useful purposes.

The growing influence of the engineer in our modern world makes it necessary that he have a more-than-passing acquaintance with the humanities and social science. Our ever-expanding knowledge of the physical sciences

Based on an address presented at a joint Production Engineering Division-American Institute of Industrial Engineers-Management Division Luncheon at the Semi-Annual Meeting, Detroit, Mich., June 15–19, 1958, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

Chrysler Corporation, Detroit, Mich.

THE FUTURE



For 25 years the author's company has conducted a 2-yr. graduate program awarding the degree of master of automotive engineering, and a co-operative program being established with a state university will provide a master's degree in engineering science

has enlarged the knowledge he must have of scientific fundamentals. At the same time, the number of specialized areas in which the engineer is involved has increased tremendously. This being the case, how can we expect to teach in four years everything the engineer needs to know? The answer is, of course, this: *We cannot*.

The most we can hope to accomplish in the 4-yr curriculum is to give the student a solid base upon which to build his professional practice. His specialization should come from the graduate school or the company that hires him. Our advance into new frontiers, and our utilization of new devices and methods, make it imperative that the undergraduate curriculums put greater stress on the principles or "why" of engineering and less on the application or "how" of engineering.

This means that the hardware, plumbing, and wiring in the undergraduate curriculums should be drastically reduced and perhaps eliminated entirely: Ways of using a particular piece of machinery or equipment, short cuts in procedures, manufacturing processes—there is not enough room in the 4-yr curriculum for this kind of instruction. And even if there were room, a college could not hope to train engineers for every kind of job.

This kind of training is largely a job for industry. Industry is better prepared and better equipped than the colleges to teach the practical side of engineering. It is industry that originates and develops the skills and methods, and procedures of engineering. And industry has far more facilities and far greater means to provide the thorough and up-to-date training that is needed in specialization.

This doesn't mean that the laboratories should be taken away from engineering schools. To be sure, "hardware" instruction should be eliminated. But laboratory courses would still be essential to illustrate the fundamental application of scientific theory taught in the classrooms. More important, laboratory courses would play a major role in developing the student's initiative and his ability to judge. The laboratory should be a place to explore, to integrate ideas and material from the classroom, to learn the basic methods of solving problems and arriving at decisions.

Changes in the Curriculum

No particular method of effecting these changes is being advocated. The goal can be reached by traveling many different routes. However, one fascinating proposal advanced by the dean of one of our leading engineering colleges gives an idea of the direction we *may* have to go to keep engineering education abreast of the rapid advance of science and technology.

Under this proposal, the traditional departmental designations—mechanical engineering, electrical engineering, civil engineering, and so forth—would be abolished. In their place would be three departments: One dealing with energy, another with materials, and a third with man.

The engineer has been traditionally concerned with energy and materials. But we've been slow to give recognition in our college curriculums to the fact that engineering is vitally concerned with the behavior of man and his response to technology. This proposal elevates the area of study dealing with human relations to an equal position with the areas of energy and materials. Under the "man" department would be such subjects as business management and organization, industrial engineering, operations research, business law, personnel supervision, and the like.

The engineering student would select his courses in much the same way as a liberal-arts student does. He would have a major in one area and a minor in another. He would be able, for instance, to major in electronics and minor in metals. Or he could have a major in heat energy and a minor in "man" courses.

He would take 30 to 40 per cent of his total number of credit hours in his major and 10 to 12 per cent in his minor. About 25 per cent of the total would be devoted to the humanities and social sciences—economics, psychology, philosophy, and the like. The remainder of the courses—25 to 35 per cent of the total—would form a core of basic subject matter which all students would be required to take. This core, which is common to all kinds of engineering, would include mathematics, chemistry, physics, applied mechanics, statics and dynamics.

TRAINING FOR THE FUTURE

This plan will be put to a test in the near future. The major advantage of organizing engineering education in this way is that it gives the student a broad understanding of the sciences and humanities and a strong base of fundamentals in the general areas in which he intends to work. At the end of four years he is ready to acquire greater depth in the graduate school or take on the specialization of industry or government.

Advantages and Disadvantages

Another advantage is that it would get rid of most of the overlapping of instruction which we now have in many of our engineering schools. Thermodynamics, for instance, is frequently taught by the mechanical engineering, the chemical engineering, and the physics departments; and it's virtually the same kind of thermodynamics until the student gets into advanced work. Elimination of this kind of overlapping would help increase the quality and effectiveness of instruction and at the same time reduce expenses by a sizable amount.

Still another advantage is that it breaks up the uneasy combinations that have developed in the traditional divisions of engineering. Take civil engineering, for example. The civil engineer is concerned largely with four things: Structures such as buildings and dams, water supply, sanitation, and highways and transportation. Occasionally these four areas tie together in practice. But how much in common does the student studying to be a sanitation engineer have with the student studying to be a highway engineer?

The biggest drawback of this proposal is that it does destroy the historical framework of engineering. For this reason it will probably run into a good deal of opposition from engineers and educators who for one reason or another want to cling to tradition. But if we are to meet the tremendous future needs for engineers of the highest competence, and if we are to prepare today's engineer for the technological and social challenges of tomorrow, we may have to depart even further from tradition.

Engineering Education in the Future

Isn't it possible, for instance, that sometime in the future we will have to educate the engineer in much the same way as we now educate the doctor? The student would take four or five years of basic engineering and science, and then a year or two of internship on the job. After completing his interne's training, he would begin his studies in a specialized field.

Or perhaps we will need two kinds of engineering schools. One would train operational and production engineers. Its curriculum would emphasize technique and method. The other would train engineers for research, for the development of new products, for the design of structures and processes. Its curriculum would emphasize scientific and mathematical fundamentals.

As many of our engineering schools drop instruction in specialized technique, it seems certain that company training will have to play an increasingly important role in the development of the engineer. Every company, large and small, will need a training program of some sort, whether in the classroom or on the job. In an era when competition for technical personnel of all kinds will be intense, companies that do not offer substantial educational opportunities will find it increasingly difficult to attract the engineers they need.

The basic objectives of company training will remain as they are today—to orient the engineer to his new organization and to teach him how to apply the knowledge he has acquired in college to the needs of the company. However, there are indications even now that company training schools will have to expand their activities well beyond these basic areas.

Whatever the uncertainties of the future, this much seems clear: The engineer's jobs will change radically and they will change often. He will be called upon to solve many more problems than he solved in this generation. And he will occupy a place of far greater importance to his community, to his nation, and to the world at large.

This being true, our education of today must prepare the engineer to meet the challenges of a fast-moving, fast-changing future—to explore new frontiers, to tackle new jobs. It must teach him to look beyond his slide rule to the needs of men and nations. It must give him the ability to relate the advancement of science to the human community.

If we are to reap the full benefits of technology and science, we will have to make certain that education and industry develop in sufficient numbers the kind of engineer from whom new ideas, new methods, and new products will come—engineers with versatility, foresight, imagination, a sound scientific foundation, and a healthy appetite for change.

Optimum Stocks of Maintenance Stores

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An engineering approach and simplified control and accounting procedures can reduce the working-capital investment in maintenance stores supplies and spare parts. Ready availability of essential items providing for minimum production down time can still be achieved.

THE maintenance operation in many large companies is a multimillion-dollar business, with maintenance material representing approximately 40 per cent of the total expenditure in the chemical industry and representing a substantial amount of working capital. Although these costs are sizable they can be secondary to production losses caused by the lack of a replacement part, wrong specifications, or deteriorated material. To state it simply, the problem is one of having the required materials on hand with the lowest material inventory.

Three important aspects of maintenance stores—parts requirements, their distribution, and their control—will be considered. The scope encompasses the functions of maintenance, operations, purchasing, stores, and accounting as they apply to this problem. A practical balance will be maintained between the newer mathematical theories and the time-tested plant practices.

The cost penalty for the shutdown of a $10-million chemical plant with an annual expenditure of approximately $400,000 for maintenance materials and a stores stock of $100,000 could be $6000 per day or higher. In many cases, the high cost of maintenance stores has been reluctantly accepted as a necessary burden when an engineering analysis would have revealed many cost-reduction possibilities.

Stock Requirements

One of the most important aspects of maintenance stores from a cost standpoint is the determination of stock requirements. These items can be divided, in general, into three categories: (*a*) Standard supplies or stores items such as nuts, bolts, and pipe fittings with a predetermined rate of use or turnover and approximate known requirements; (*b*) insurance items or protection spare parts which do not have established turnover but must be available to avoid costly production shutdowns; (*c*) complete assemblies or machines which are often referred to as spare equipment, and which are usually capitalized. Proper classification is necessary both from an analysis and accounting standpoint.

While the quantity of stores stock to be maintained in these different categories can be the responsibility of different organizations, handling and accounting are usually the responsibility of the Stores Group, and this group is usually a part of the accounting organization. Development of capital spares and spare-parts requirements is generally a function of Works Engineering, while stores items may be a joint responsibility.

The investment in stores, spare parts, and capital spares must earn a return the same as any other investment. This can be stated as:

$$\text{Return on investment} = \frac{\text{profit}}{\text{investment}} = \frac{\text{sales less cost of product}}{\text{investment}}$$

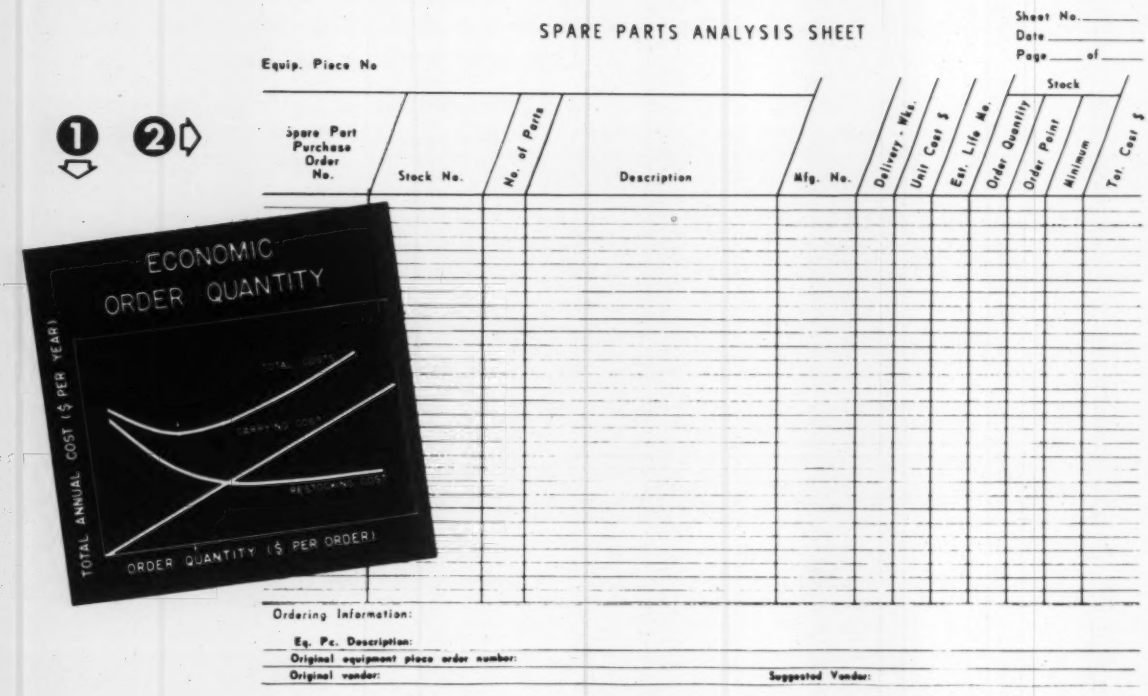
It is obvious that in regard to maintenance parts, return can be improved by: (*a*) Reducing parts investment if the inventory is unnecessarily high; (*b*) increasing the investment in parts or units if this reduces process-equipment down time and thereby increases production and sales; (*c*) maintaining the same total investment in stores material but with the proper quantity of the required items.

Determination of Parts Requirements

Stores items are the low-unit-value parts having high turnover. A maximum-minimum system provides a very sound approach to controlling this type of stores material. Basically it consists of: (*a*) A minimum or protective stock level which is a function of the cost of a stock-out, demand for the item, and availability of replacement supplies; (*b*) an order point which is established by the delivery period of replacement stock; (*c*) an order quantity which, in conjunction with the order point, establishes the maximum stock level.

Realistic rather than rule-of-thumb order quantities can be established by means of the economic-order prin-

Contributed by the Maintenance and Plant Engineering Division and presented at the Maintenance and Plant Engineering Conference, Pittsburgh, Pa., April 14–15, 1958, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Condensed from Paper No. 58—MPE-1.



ciple. Basically this is a simple method of balancing carrying costs and restocking costs to obtain the minimum total costs, Fig. 1. The economic-order quantity is that quantity of a specific item which results in the minimum total cost when both restocking and carrying costs are considered and included.

The formula for economic-order quantity, found in standard works on the subject, is a square-root function of the annual consumption of an item expressed in dollars.

$$EOQ = \left(\frac{2AK}{I}\right)^{1/2}$$

where

EOQ = economic-order quantity, in dollars
A = annual requirements, in dollars
K = restocking cost per order, in dollars
I = carrying cost, in decimals

The unit cost of restocking and unit carrying costs are constants for a particular plant. Once determined, they need only be modified for major changes in policy or routine. Unit-restocking cost represents variable reordering costs. These vary with the number of orders placed and include the cost of writing and placing of orders, filing, expediting, communicating, and invoicing.

Carrying costs include obsolescence, interest on the required working capital, storage costs, and similar factors, and may also be considered to represent the return required on stores investment. These carrying costs often amount to 15 to 25 per cent of the investment required.

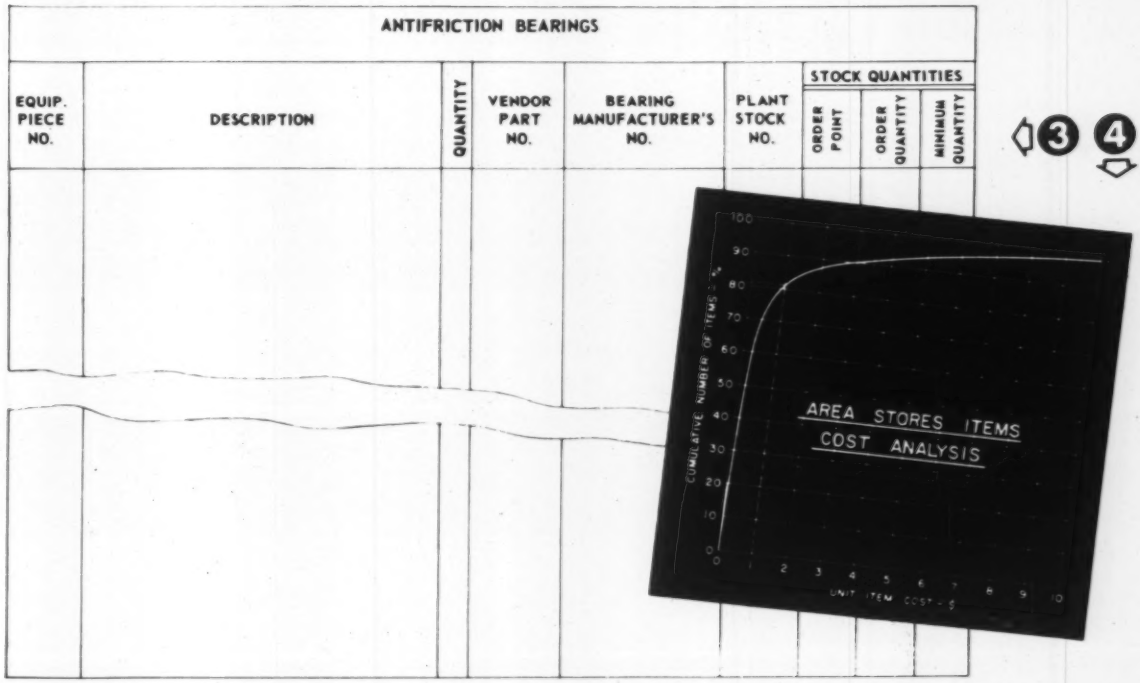
Once the unit restocking and carrying costs are determined, a curve or table such as shown in simplified form in Table 1 can be developed to suit any particular requirement. An annual consumption of $100 worth of a specific type and size of gasket with a $3 unit-restocking cost and a 20 per cent carrying cost would indicate an order frequency of six months. A $10,000 annual consumption of the same item would increase the order frequency to once every three weeks. It is obvious that, in this system, control is concentrated on those items where the dollar expenditures are high, but it does allow evaluation of all items. Emphasis is placed on the vital few and not on the insignificant many. Through this approach the cost of frequent ordering of the many low-cost items with its excessive clerical expense, which can exceed the purchase price, is optimized without significant increase in the stores investment. Conversely, more frequent ordering of the high-dollar-volume items will substantially reduce investment without appreciably affecting restocking costs.

Plant experience with this technique has been very favorable, reducing stores investment approximately 50 per cent in one case and the number of orders placed for another plant by 50 per cent. In a third case both lower investment and clerical costs were obtained.

Several other factors should be considered in establish-

Table 1 Economic Order Quantity for a $3.00 Restocking Cost and a 20 Per Cent Carrying Cost

Annual Requirements, $	EOQ, $	No. of orders per year	Order period
100	55	1.8	6 months
500	123	4.1	3 months
1000	174	5.7	2 months
5000	388	12.9	4 weeks
10000	548	18.2	3 weeks
50000	1228	40.8	9 days



ing the economic-order quantity. One of these is quantity discounts which can increase the economic-order quantity. On an item with a $1000 annual consumption, normally ordered six times per year, a 1 per cent discount will permit ordering only three times a year, while a $7\frac{1}{2}$ per cent discount could reduce this to once a year.

Other Considerations

No formula or table will replace common sense and good judgment, but can merely aid in arriving at the best answer. For example, space limitations, limited shelf life, or possible obsolescence may be the determining factors which would dictate smaller quantities than otherwise indicated.

Once the order quantity has been determined, it is necessary to establish when this quantity should be ordered. It is good practice to consider both a minimum stock level and an order point. Used together they can provide insurance against stock-outs of stores items. The order point should be equal to the minimum stock plus the average demand during the delivery or procurement period. Since a statistical analysis of the cost resulting from a stock-out generally is not justified for the thousands of stores items which, unlike spare parts, have little effect on production, minimum stock levels can be based on experience alone. There is a relationship between the order quantity, minimum-stock level, and stock-outs. An increased order quantity tends to reduce stock-outs by reducing the number of orders placed.

In contrast to the low-cost high-turnover stores items, spare parts usually have a higher unit cost and often are slow-moving. Many spare parts are protection or insurance items which would affect production critically if not readily available, and the cost of restocking them is small compared to stock-out and carrying costs. The cost of a stock-out is a function of the unit cost of down time, its frequency which is determined by equipment life, and the duration of the down time which is controlled by the parts-delivery time. The carrying cost is a function of the purchase price of the item and the carrying charge expressed as a per cent of investment. Although the mathematics can be relatively simple, the problem is one of having records covering a long period of time to give the required data on down time.

Since one of the most difficult and time-consuming tasks in setting up parts requirements is that of obtaining such information as part specifications, price, and delivery, particularly where the equipment manufacturer has substituted his own part numbers for those of the original manufacturer, it is good practice to request such information in the original purchase orders. In addition, it is important to assemble the information in an Equipment Reference File containing a copy of all correspondence, purchase orders, parts lists, drawings, manufacturer's installation, operating and maintenance instructions, catalog data, price lists, and similar information.

Analyzing Spare-Parts Requirements

With this reference material, it is possible to start an engineering analysis of spare-parts requirements of the type shown in Fig. 2. A separate sheet is used for each piece of equipment or group of similar equipment pieces. All parts considered to be a maintenance problem are tabulated. Where it is decided not to stock a part because it can be reconditioned or refabri-

cated in the shop, is stocked locally, or substitutes are available, this and similar information are noted on the analysis sheet.

In general, the information on quantity, price, and delivery is weighed along with considerations such as probability of failure and effect on production to determine parts requirements. A mathematical analysis can be made where a particularly highly priced item is involved. In addition to the equipment-analysis sheet, a parts-recapitulation sheet is of considerable value. The purpose of this step in the analysis is to consider on a plant-wide basis widely used items such as bearings, seals, valves, and V-belts.

Fig. 3 shows a "recap" sheet which might be used for bearings where the additional problem of converting bearing numbers to a common code is involved. Final selection of quantities to be stocked is based on the plant-wide use of the part rather than the accumulated total for the individual units.

Experience has shown that with a more thorough analysis, an adequate inventory can be maintained with a lower investment in parts. This is due in part to the elimination of part duplication but primarily from a consideration of all significant engineering and economic aspects. In a chemical plant, a detailed analysis of stores and spare parts will indicate an expenditure generally of less than 1 per cent of plant investment for all items. In a recent case the detailed analysis of experience with an existing plant resulted in stocking the new multimillion-dollar plant with only $10,000 worth of parts while still providing ample protection.

Complete or self-contained units such as pumps, motors, and tanks are analyzed in the same way as spare parts. The only difference is that complete units usually are capitalized and classified as extra machinery or capital spares, and a detailed economic analysis is usually indicated by the high cost. The time required to install it, the possibility of using it at more than one location, and the cost of down time would decide whether the item should be installed or stored until needed.

Parts-Storage Location and Distribution

Even with a frequent truck delivery system a central stores alone may not be adequate in a large plant. In this situation, low-cost, high-turnover items can be supplied to the area maintenance shops on a weekly basis, where availability and self-service issue without a ticket saves maintenance-labor time and also reduces clerical work.

When area stores supplement central stores, they should be limited to a 7 to 10-day supply and controlled by means of a simple weekly inventory and order form. By comparing consumption with the maximum stock for a several-weeks period, it is readily possible to adjust the stock level to a realistic figure.

Table 2 Maintenance Stores

Parts requirements	Distribution
Economic-order quantity	Central stores
Quantity discounts	Area stores
Stores catalog	Administrative controls
Equipment reference files	Turnover
Spare-parts analysis	Simplified accounting
	Periodic review

A maximum unit cost of $1.00 is often representative of 80 per cent of the stores normally used in the area, and a $0.50 maximum unit cost would cover approximately 70 per cent of the items, Fig. 4. Usually spare parts and certain items promiscuously used or misused are not stocked in the area.

For cost-distribution purposes the charges for area material can be allocated monthly to the various area cost codes based on the maintenance-labor distribution; or a periodic sampling will establish the percentage and result in an equitable distribution.

Experience with this system has been good. Better control of material in the area and better accounting have resulted.

Administrative Controls

The administrative controls should give a broad picture quickly, be easy to develop, and inexpensive to maintain. For management-control purposes stores items can be divided into groups under various captions. Typical captions can be pipe, electrical, mill supplies, paint, and oil. Turnover by caption actually provides the control.

$$\text{Turnover} = \frac{\text{avg dollar inventory}}{\text{dollar consumption/month}}$$

A turnover of one to three months might be considered satisfactory depending on the caption. However, turnover must be used as a control only with the utmost caution, because of the adverse effect of reduced inventory on production and on maintenance-labor effectiveness. When used properly the trend of turnover can quickly provide an indication that the stores operation needs attention.

In recent years, management has tended to critically re-examine controls and paper work that had been regarded as essential. As a result, several cost-saving policies such as cents elimination,[1] bin control, and free issue[1] of low-cost items are now accepted practices.

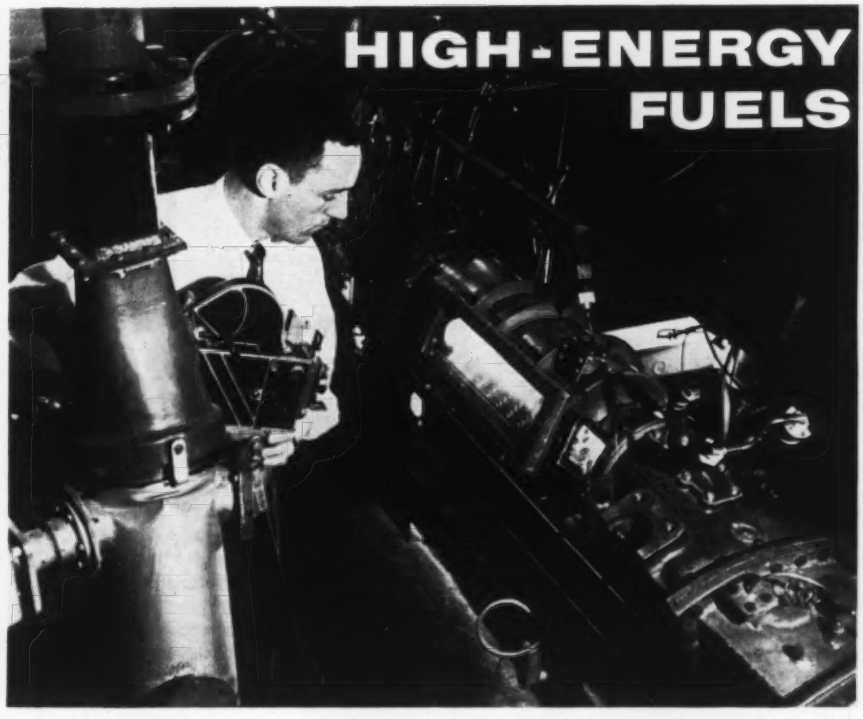
Bin control relies on stock reordering based on the number of items actually in the bin rather than that posted on an inventory card in the office. Bin control eliminates the need and cost of a perpetual-inventory card system, and results in fewer stock-outs.

Conclusion

There are many other phases of maintenance stores which are important. However, from a maintenance-engineering standpoint, the aspects of type and quantity of items stocked, their distribution, and degree of control are of primary importance. In summary, these can be further defined as shown in Table 2. Through these techniques, a sound balance between the desires of maintenance and the historic concepts of accounting can be realized. In principle, these techniques are applicable to maintenance stores in any plant, large or small, where either electronic computers or a manual system are in use.

The justification for the use of these techniques includes reduction in production down time, improved maintenance-labor effectiveness, reduced clerical work, and improved control.

[1] The term "cents elimination" simply means charging out items to the nearest whole dollar, and "free issue" is an accounting technique whereby certain very-low-cost items are charged directly to cost without individual accounting, although a stores order may be required for issue.



HIGH-ENERGY FUELS FOR AVIATION

By R. A. Wells

Gulf Research and Development Company, Pittsburgh, Pa.

Combustion chamber under the camera's eye. Being tested is a diborane fuel. This is part of the NACA research program on the boron fuels.

An introduction to high-energy fuels: Four types, and their performance when applied to their intended aviation power plants. A state-of-the-art summary.

HIGH-ENERGY fuel: To the aircraft engine manufacturer it means a fuel which will allow his present and/or future models to produce more power. To the air-frame manufacturer it means a fuel which can be squeezed into smaller tanks and/or will not weigh as much. To the aircraft operator it means a fuel which will enable him to carry more passengers or cargo faster for longer distances at lower direct operating costs.

Bases of Comparison

For air-breathing engines, high-energy fuels are usually compared on the basis of heat release per unit weight, or Btu/lb; but there are also other bases, such as Btu per gal for space-limited aircraft, and flammability limits where extremely high-altitude performance is desired.

For rocket engines, which do not use the air as their source of oxygen to burn their fuel, energy level is compared on the basis of specific impulse. Specific impulse or I_{sp} is pounds force of thrust developed per mass of propellant exhausted per second and is a measure of the difference in total heat of propellant gases before and after expansion.

Contributed by the Aviation Division and presented at the joint Aviation Conference, Dallas, Texas, March 16–20, 1958, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS and the American Rocket Society. Condensed from ASME Paper No. 58—AV-26.

Most turboprop and turbojet-powered airliners are expected to operate on aviation grade kerosene, also known by its ASTM designation, "Turbine Fuel A," although at least one uses JP-4. A high-energy turbine fuel, from our introductory remarks, would be one having higher Btu per lb, and also more Btu per gal, than Turbine Fuel A. Next year's airplanes are designed and built, and a high-energy fuel would have to be compatible with present hardware.

Fuel cost has been estimated to be approximately 40 per cent of direct operating costs, for turbine-powered airplanes. With the proposed new fuel taxes, this percentage may increase further; therefore, it is important for the commercial operator to have the lowest possible fuel cost (in this case, cents per Btu). Turbine Fuel A and JP-4, being petroleum products in plentiful supply from existing refining facilities, meet these requirements and no high-energy versions of commercial aviation turbine fuels are being offered in this cost range.

The Military Forces have more strategically important requirements, namely, increased speed and range with global availability. A fuel having conventional physical characteristics along with the present minimum 18,400 Btu per lb, and an increased Btu per gal, could allow present-day aircraft to fly longer distances without refueling by carrying more Btu's in the same fuel tank volume.

Fig. 1 illustrates the effect of high-energy fuel on aircraft gross weight and range.

Turbines Impose a Limit

In a turbine engine, the hotter the combustion gas temperature, the more power the engine will produce; but the allowable turbine-wheel temperature limits the allowable gas temperature. Therefore, a fuel having high Btu/lb will have to be burned at a leaner fuel/air ratio or it will cause the turbine wheel to overheat. The reduction in fuel/air ratio necessary to maintain constant turbine wheel temperature is shown in Fig. 2.

Military turbine engines operate on JP-4 fuel which is a relatively "wide-cut" fuel in both the gasoline and kerosene boiling range. Average Btu per lb, 18,703; average Btu per gal, 119,885.

A high-energy fuel for this application shoots for 140,000 Btu per gal with at least 18,400 Btu per lb and an abundant supply to make it logistically practical.

Unfortunately, with hydrocarbon fuels from petroleum, as the Btu per gal increases, the Btu per lb decreases and aircraft range moves along the same lines. This relation is shown in Fig. 3.

In addition to heat content, a practical fuel for advanced weapon systems (the Air Forces no longer fly airplanes—they operate weapon systems) must have certain other important characteristics[1].[1] They are: Good thermal stability; good combustion characteristics; close definition of properties; best low-temperature properties commensurate with the other qualities.

The Tanks Get Hot

As aircraft and missiles are powered to fly faster, aircraft-skin temperature begins to rise. At slightly above Mach 2, the skin temperature (fuel tank side) of an aircraft at 70,000 feet is 300 F. The engines of present and future air-breathing aircraft depend on the fuel in the tanks to take the heat away from their lubricating oil by use of fuel-oil coolers. These two sources of heat, plus the heat added to the fuel as it flows from the tank past the hot engine into the combustion chamber, adversely affect the fuel's deposit-forming properties.

A fuel which resists change from outside sources of heat is said to be thermally stable. Thermal stability is one of the most important fuel characteristics for high Mach aircraft.

[1] Numbers in brackets designate References at end of paper.

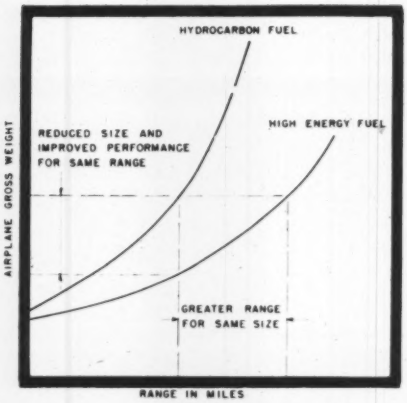

HYDROCARBON FUEL
HIGH ENERGY FUEL
REDUCED SIZE AND IMPROVED PERFORMANCE FOR SAME RANGE
GREATER RANGE FOR SAME SIZE
AIRPLANE GROSS WEIGHT
RANGE IN MILES

Fig. 1 Aircraft performance increases with high-energy fuel—more Btu in the same tank. Present min: 18,000 Btu per gal.

Petroleum products are mixtures of straight-chain, branched-chain, and cyclic hydrocarbons and, therefore, are not the ideal solution. As a step toward a more thermally stable fuel than JP-4, the Air Force has set up requirements for JP-6, which is a special cut and more thermally stable petroleum fuel with less severe freeze point requirements.

Applying the range formula to a modern turbojet airplane we arrive at the information shown in Fig. 4, where maximum range with JP-4 is increased by filling the fuel tanks with JP-6 and then with four dicyclic hydrocarbons. Physical characteristics of these pure chemical materials are shown in Table 1.

Theoretically, aircraft range could be increased by as much as 20 per cent by loading the aircraft tanks with Fuel E, but only 100 lb of payload capacity would remain. Other fuels and other aircraft would give varying results. High-density hydrocarbon fuels of these types, along with JP-6 and RP-1 (petroleum rocket fuel), are expected to be a very small percentage of the total military fuel for the foreseeable future with JP-4 the highest volume product, surpassing avgas by 1960.

Future programs call for more thorough examination of alkylated derivatives of basic polycyclic hydrocarbon structures. Alkylation apparently improves these materials, giving: higher heating value per unit weight;

Table 1 Physical Characteristics of JP-4 and Five High-Energy Fuels

	JP-4	JP-6	C[a]	D[b]	E[c]	F[d]
Specific gravity	0.77	0.80	0.89	0.94	0.98	0.88
Lb per gal	6.41	6.67	7.41	7.83	8.16	7.32
Heat content						
Btu per lb	18,703	18,474	18,200	18,260	18,130	18,460
Btu per gal	119,885	125,300	135,000	143,170	148,450	135,860
Aircraft range						
Max naut mi	5,200	5,370	5,700	6,060	6,240	5,820
Aircraft payload						
Max lb	35,900	32,400	16,400	5,470	100	18,400

[a] Fuel C is decalin.
[b] Fuel D is perhydrofluorene and perhydrophenanthrene.
[c] Fuel E is perhydrofluoranthene.
[d] Fuel F is isopropylbicyclohexyl.

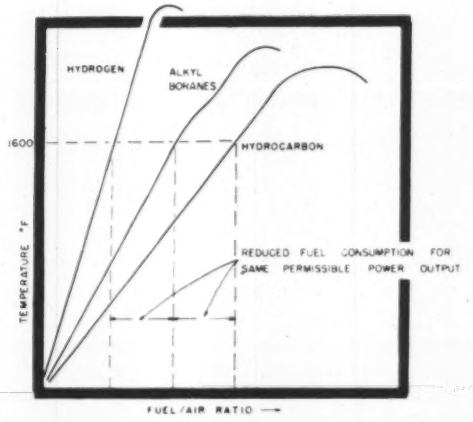


Fig. 2 With higher Btu per lb, the fuel-air ratio may have to be reduced to keep temperatures safe for the turbine wheel

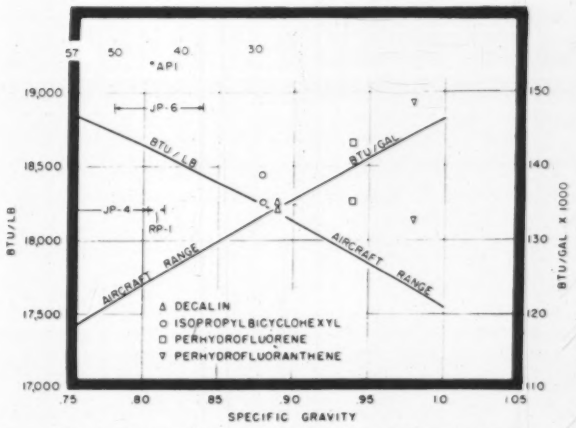


Fig. 3 For petroleum hydrocarbons, weight rises too fast with Btu per lb. Aircraft range is not improved. Also shown are hydrocarbons with better patterns.

higher heating value per unit volume; lower freezing point; lower viscosity.

The heating values of several of these polycyclic materials are also illustrated in Fig. 3 in comparison with petroleum products.

Aromatics are not being considered, even though their decomposition temperatures are desirably high, because their use causes serious combustion problems. Saturated materials also have considerably higher heating value per lb than corresponding aromatics.

Pyrophoric Fuels

Several types of air-breathing engines show distinct advantages for long-range weapon systems. One is lightweight as compared to rockets. Pyrophoric fuels (liquids which ignite spontaneously in air) increase this weight advantage for ramjets by permitting the same amount of thrust to be taken from a much smaller, less complicated and, therefore, lighter and more reliable unit than with hydrocarbon fuels.

Ramjet speed range is considered 0.7 to 3.0 Mach. A 1.5 M ramjet to burn pyrophoric fuel has been designed for constant-altitude target drone or missile application, which is 24 in. long, $7^1/_2$ in. in diam, and weighs 18 lb. If hydrocarbon fuel were used for the same application, the unit would have to be completely scaled-up and redesigned to include flameholders, ignition system with harness, and much larger fuel tanks. Dollarwise, a $600 engine is possible as compared to $5000 to $10,000 for a similar petroleum-fueled unit.

Weapon systems with pyrophoric fuels can fly faster at higher altitudes with leaner mixtures and, therefore, better fuel economy with increased reliability. They virtually eliminate high-altitude flameout which forces an aircraft to abort its mission and glide back to more dense air to relight.

Another use of these materials has been found as an igniter injected into the combustion chambers of turbojet engines [3]. Also, afterburner thrust may be increased as much as 20 per cent by injecting 5 per cent of pyrophoric fuel along with hydrocarbon fuel to increase flame speed. Injection of pyrophoric fuels can also be used to keep the flames within the afterburners.

Besides the use of pyrophoric fuels in 100 per cent concentrations, they are being considered as admixtures to hydrocarbon fuels, and for use by secondary injection. In concentrations of 15 per cent, and even up to 30 per cent for small-size units, this additive approach improves burning and reduces screech in rockets, allows more reliable operation at higher altitudes and leaner fuel/air ratios.

Pyrophoric fuels now available for testing are organometallic compounds. Three have been prominent in this field—TEA, TEB, and TMA (triethyl aluminum, triethyl borane, and trimethyl aluminum). Recently a new material, TBB (tributyl borane), has been synthesized which has very high flame speeds and blowout velocity with the unique safety feature that it does not burn when exposed to air, but must be sprayed before it exhibits its pyrophoric characteristics. Information on its properties is incomplete [3, 12].

Logistic Problems

Pyrophorics have not been more widely used due to the logistic problems inherent with handling chemicals which are not compatible with many materials or any people. For instance, TEA ignites spontaneously with air and is said to be hypergolic with liquid oxygen in both gaseous and liquid phases. It also reacts violently with active hydrogen compounds such as alcohols, acids, amines, mercaptans, as well as many halides, and therefore must always be kept in a dry and inert atmosphere. TEA and TEB are extremely destructive to living tissue and on contact with the skin produce a combined effect of dehydration and thermal burn. The reaction is immediate and deep burns with subsequent scarring result.

No leaks can be tolerated due to resultant fire. The prepackage concept with bladder tanks and with leakless quick-disconnect fittings, and more stable pyrophoric materials, could overcome many of the logistic reservations. Unlike TEA, TEB does not react with water, and TBB does not even react with air until sprayed. These materials appear to be thermally stable and, therefore, suitable for high M aircraft. Poor lu-

bricity may give problems with pumping and may lead toward the use of pressurized or bladder tanks.

Project "Zip"

The most widely publicized high-energy-fuel program and the one which coined the words in the Navy's project "Zip," started in 1952 and was joined by the Air Force in 1955. This multimillion-dollar program, based on diborane, resulted in a major fuel technology break-through in the form of a new series of boron-carbon-hydrogen compounds retaining much of the high energy of the boranes but more stable, less toxic, and of higher density.

No data can be given in an unclassified paper on the specific properties of the several HEF and HiCal fuels, but information is available on several of the boron hydrides which closely resemble these B-C-H fuels. It is generally understood that these fuels differ from the boranes by the substitution of alkyl groups for some of the hydrogen [13]. Ethyl alkylated decaborane has been stated to be a liquid fuel designated HEF-3; whereas decaborane is a solid material [9].

The boron hydrides have been extensively investigated in both small-scale and full-size burners at NACA Lewis Propulsion Lab. The Btu-per-lb rating of these high-energy fuels with some of their competitors are shown in Table 2.

High Heating Values—Plus

The high heating values of the boron hydrides are attended by extreme reactivity which is a real advantage if it can be controlled within a jet engine. A more reactive fuel burns more completely under a wider range of conditions. This means an aircraft can fly higher without flame-out caused by low pressures at very high altitudes.

When a hydrocarbon fuel (ethylene) was compared to diborane under the same exhaust temperature and airflow conditions, the fuel flow for diborane was 53 per cent as much as for the hydrocarbon to produce the same amount of heat [5]. (Diborane if used in an aircraft or missile would be a cryogenic or low-temperature fuel because, like hydrogen, it is a gas at flight temperatures and pressures. Its −92.4 C boiling point, however, is substantially above the boiling point of liquid oxygen.)

With this same equipment when the air flow is increased to simulate higher flight speed in a ramjet, the hydrocarbon flame is blown away at 47 fps as compared to the diborane flame which remains intact at 100 fps, in spite of the fact that flameholders were used for the hydrocarbon fuel and not for the diborane.

Table 2 Characteristics of High-Energy Fuels

	Form	Btu/lb	Density	State
Hydrogen	H_2	51,500	0.000089	Gas
Beryllium	Be	29,100	1.8	Solid
Boron	B	25,400	2.0	Solid
Diborane	B_2H_6	31,300	0.0012	Gas
		31,100	0.46 (−92.4° C)	Liquid
Pentaborane	B_5H_9	29,100	0.631	Liquid
Decaborane	$B_{10}H_{14}$	27,900	0.94	Solid
		28,200	0.72	Liquid
Alkylborane	B-C-H	25,000	0.82 [13]	Liquid
Jet fuel	JP-4	18,700	0.77	Liquid
Rocket fuel	RP-1	18,580	0.81	Liquid
Jet fuel	JP-6	18,400	0.80	Liquid

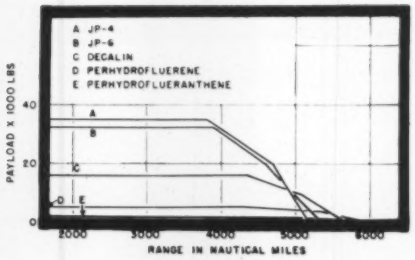


Fig. 4 Effect on range and payload for a turbojet of 290,000-lb gross, 36,000-lb payload, and 21,600-gal fuel capacity. Fuel F of Table 1 plots on same line as C.

In a turbine engine burning B-C-H fuels, boric oxide deposits on primary combustor walls, turbine stators and rotors, afterburner walls, injectors, flameholders, and variable-area nozzles. When liquid pentaborane is used to operate a turbojet, the liquid oxide film flowing along with the exhaust rapidly builds up to $^1/_8$-in. thickness [6]. Conventional turbine engines won't stand this for long.

For afterburners or ramjets, these oxides do not pose the same problems as there are no rotating parts. However, the corrosion and abrasive erosion caused by the combustion products do cause serious problems even in these relatively simple power plants.

We expect this type of fuel to be used in these power plants while research on both the fuels and engines continues toward a solution to the turbine problem with HEF and HiCal liquid fuels.

Vapors from boron hydrides are extremely toxic above 0.1 ppm, explosive in air, and react with water. The explosion hazard of the boranes varies from the spontaneous ignition of pentaboranes in the presence of oxygen to the explosiveness of solid decaborane if exposed to oxygen above 100 C [4]. The modification of the boranes into HEF and HiCal has apparently reduced their vapor pressure, which reduces the likelihood of having explosive or toxic vapor concentration. One fuel producer reports an accident level substantially lower than the chemical industry average [12].

The Neighbors Won't Like It

The boric oxide thrown into the air by burning the boranes leaves a dense cloud which covers a wide area. In high concentrations it is feared continuing operations in a given area may affect plant life and, of course, interfere with ground operation of aircraft and personnel, if used during take-off.

High-energy fuels are military fuels primarily due to their high cost. Even with the full production predicted price of $1/lb, HEF and HiCal are 50 times more expensive than hydrocarbon fuels. However, for some

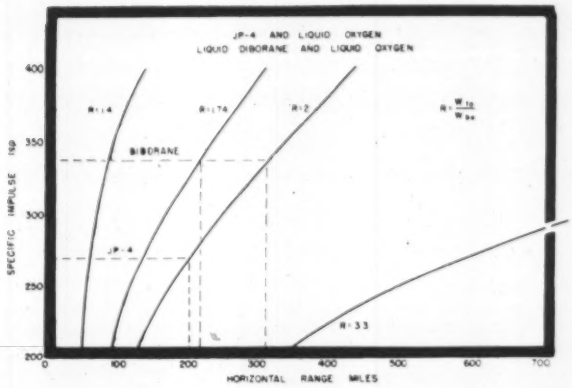


Fig. 5 Single-stage rocket—how its range is affected by specific impulse and mass ratio (R). Same hardware: only the two variables are considered. Mass ratio is the ratio of weight at take-off to weight at burnout.

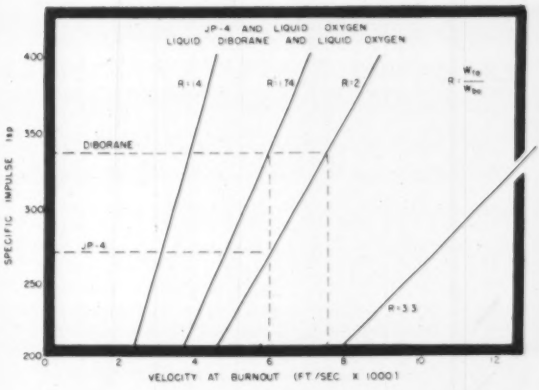


Fig. 6 How changes in specific impulse and mass ratio affect the range of a single-stage rocket. Low density of borane adversely affects its mass ratio, offsetting the theoretical increase in specific impulse.

missions and some weapon systems, boron fuels may do the job better than our present fuels; and for some weapon systems, only boron fuels may be able to meet the military requirements. Under these conditions the cost of fuel is a relatively small consideration.

The B-70 supersonic weapon system is probably an example of this fact. The hydrocarbon fuel consumption to push a supersonic bomber for long ranges is very high and apparently would require refueling en route to a target. If performance could be increased by 30 to 50 per cent, as reported in the popular press, by the use of boron hydride fuels, it might be possible to eliminate the need for advanced bases, personnel, refueling aircraft, etc. Then, the additional cost of high-energy fuel in dollars per lb might be economically as well as strategically sound. If the range of an aircraft carrier-based aircraft or missile could be increased 40 per cent, the area it could control would be doubled.

Rockets: Specific Impulse

Rockets look down their long slim noses at performance based on Btu/lb alone. Rocket fuels are compared on the basis of a system of their own called specific impulse or I_{sp}. The rocket, both liquid-fueled and solid-fueled, carries both an oxidizer and a fuel. We are concerned here only with high-energy fuel, even though different oxidizers influence the I_{sp} of propellants (fuel plus oxidizer). The I_{sp} of JP-4 in liquid oxygen at 600 psi is 271.8. By blending liquid oxygen with 30 per cent fluorine, the I_{sp} is increased to 301 [8].

Among the many oxidizers available, the following fuel comparison is based on the use of liquid oxygen which has the very attractive advantage of being available from air and, therefore, can be produced on the site. It can also be stored for reasonable times; a spill causes no difficulty; it is available in unlimited quantities everywhere; and costs less than other oxidizers.

Rocket fuels are usually compared on their ability to improve one or more of the five basic rocket performance parameters. These parameters are: physical size, payload, horizontal and vertical range, and velocity at burnout. These performance parameters all have a common factor, I_{sp}.

Specific impulse is defined as lb of thrust per lb of propellant per sec, and measured specific impulse as

$$I_{sp} = T/W$$

where T = thrust in pounds
W = propellant flow rate in lb per sec

This is a very simplified formula. I_{sp} is also inversely proportional to the (average molecular weight of combustion products)$^{1/2}$.

Table 2 lists characteristics of the borane fuels. The low density of diborane adversely affects its mass ratio and offsets the theoretical increase in I_{sp}.

Fig. 5 illustrates the effect of changes in I_{sp} and mass ratio on horizontal range of a rocket, while Fig. 6 illustrates the effect of these same changes on rocket velocity at burnout. Plotted on these figures are the comparative performance data of JP-4 and liquid diborane for a hypothetical vehicle with fixed hardware; therefore, the only variables considered are the changes in I_{sp} and W_{to} due to the difference in density of liquid diborane at 0.46 as compared to JP-4 at 0.77. Diborane is combustible over a wider fuel/oxidizer range than hydrocarbons; so we have considered that the fuel tank filled to the same weight as JP-4 and then to the same number of gallons for these two comparisons. Indications are there will be no significant net difference in performance between JP-4 and liquid diborane.

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How to READ Heat Transfer in RUSSIAN

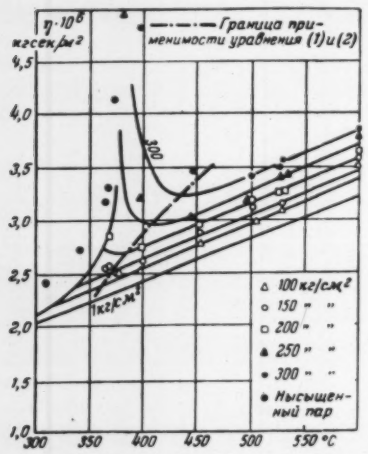
By Mrs. F. F. Buckland

General Electric Company, Schenectady, N. Y.

$$\tau_i = \frac{1}{3} L u \rho, \qquad (3)$$

где L — средний свободный пробег молекул;
u — средняя скорость поступательного движения молекул;
ρ — плотность газа.

Для реальных газов он внес поправки на конечность размеров молекул и на действие межмолекулярных сил аналогично поправкам, которые вносятся в уравнение состояния Ван-дер-ваальса. С целью получения удобного для расчетов уравнения М. Ф. Широков ограничился



Фиг. 1. Сравнение уравнения М. Ф. Широкова (1) и В. Н. Тимофеева (2) с экспериментальными данными по вязкости водяного пара.
Кривые рассчитаны по уравнениям (1) и (2); точки — экспериментальные данные.

Ability to scan an original Russian article is becoming a necessity for heat-transfer engineers. The mysterious look of the Russian alphabet is apt to act as a deterrent until one realizes that the letters are primarily Greek and English. The international aspect of the exchange of technical information has led to the adoption of common words for many languages, and a knowledge of the pronunciation of the Russian letters makes the meaning of many words immediately apparent. Other words are so ancient in origin that there is no correspondence whatsoever, and primarily for these the present vocabulary is prepared.

First, the recognizable and unrecognizable letters will be shown together with the pronunciation, and then the order in which they are found in a dictionary.

The first word the author ever recognized in Russian was Прандтл (Prandtl) emphasizing the Russian use of H for N. The second was Бернулли (Bernoulli). The third was коэффициент (coefficient). These will be recognized as modern words.

Words like heating, air, and water were in common use long before technical terms were thought of, and have Russian spelling, нагрев, воздух, and вода, respectively.

Equations in Russian use English notation, as will be seen in Fig. 1. The figure is a reproduction from "Variation of Viscosity of Water Vapor With Pressure," by N. B. Vargaftik, *Izvest. Usesoyuz. Teplotlech. Inst.*, 21, no. 1, 13–17, 1952. It shows the identity of the form of equations with what we are used to. It also shows a characteristic of Russian graphs, which almost always give the data in script form. Most of the script is like the printed letters; two important oddities are *g* and *t*, which appear as *e* and *m*. The ordinate is expressed in kg.

Contributed by the Heat Transfer Division and presented at the ASME-AIChE Joint Heat Transfer Conference, Chicago, Ill., Aug. 18–21, 1958. ASME Paper No. 58-HT-9.

Russian Vocabulary for Heat-Transfer Literature

A (a)

азотная дуга nitrogen arc.
аккумулятор 1. storage battery; 2. storage system; storage device.
альфа-лучи alpha rays.
альфа-частицы alpha particles.
ампер-виток ampere turn.
амперметр ammeter.
ампер-час ampere hour.
амплитуда amplitude.
анализ analysis.
анемометр anemometer.
анизотропия anisotropy.
анизотропный anisotropic.
анод anode, plate.
аппарат apparatus, set, device.
аппаратура equipment, apparatus, gear.
арифметический arithmetical.
атомная теория atomic theory.
атомная энергия atomic energy.
атомное число atomic number.
атомное ядро atomic nucleus.
аэро- air-, aero-.

GREEK			ENGLISH		PSEUDO ENGLISH		RUSSIAN		MUTE	
Г	gamma	g	A	a	B	v	Ж	zh	Ь	
Д	delta	d	Б	b	З	z	И	i	Ъ	
К	kappa	k	Е	e	Н	n	Ц	ts	Й	
Л	lambda	l	О	o	С	s	Ч	ch		
П	pi	p	М	m	У	oo	Ш	sh		
Р	rho	r	Т	t			Щ	shch		
Ф	phi	f					Э	e	Ы	y
Х	chi	kh					Ю	yu	Я	ya

Б (б)

баллон bulb, shell, envelope.
барабан drum, barrel, cylinder, reel.
барокамера pressure chamber, altitude chamber.
барометр barometer.
бесконечность infinity.
бета-лучи beta rays.
биметалл bimetal.
биметаллическая полоска bimetallic strip.
биномиальный binomial.
ближняя инфракрасная область near-infrared region.
блок unit, assembly block.
блочная схема block diagram.
болометр bolometer.
бумага paper.
бусинка термистора thermistor bead.
быстродействующее high-speed.
быстрота rate, speed, velocity.

В (в)

вакуум vacuum.
вакуумная сушилка vacuum dryer.
вакуумная термопара vacuum thermocouple.
вакуумный насос vacuum pump.
вал shaft.
вариант alternate.
ваттметр wattmeter.
ватт-секунда watt-second, joule.
ввод inlet, bushing, entrance, intake.
величина quantity, value, magnitude, size.
вентилировать ventilate.
вентилятор fan, blower.
вертикальное отклонение vertical deflection.
ветродвигатель wind motor, windmill, fan.
ветрянка air vane.
ветрячный генератор fan-driven generator.
вещество substance, matter, stuff, material.
взаимодействие interaction.
вид 1. mode (of oscillations, etc); 2. aspect, sight, view.
вискозиметр viscosimeter.
водонепроницаемый watertight.
водоохлаждаемая лампа water-cooled tube.
водород hydrogen.
водородное охлаждение hydrogen cooling.
водяное охлаждение water cooling.
воздух air.
воздухо- air-.
воздухонепроницаемый airtight.
воздухостойкий airproof.
воздушная изоляция air insulation.
воздушное охлаждение air cooling.
воздушный зазор air gap.
волна wave.
вольфрам tungsten.
вращающаяся запайка rotating bearing seal.
вращающееся поле rotating field.
время time.
вспомогательная аппаратура auxiliary equipment, auxiliaries, adjuncts.
входная мощность input power.
вч сварка high-frequency welding.
выверка alignment, adjustment.
выдача данных presentation of information.
выравнивание equalizing, balancing.
высота height; altitude.
выход output, outlet, exit.

Г (г)

газ gas.
газовый (*adj*) gas, gaseous.
гамма-лучи gamma rays.
гелий helium.
генераторная станция generating plant, generating station.
годовая плата annual rate, yearly rate.
горизонтальная horizontal.
горловина канала duct entrance, throat.
горячий сросток soldered joint.
градиент gradient.
граничный эффект boundary effect.
график graph, chart, diagram.
группа group.

Д (д)

давление pressure.
дальность distance.
данные data.
движение movement, motion.
двучлен binomial expression.
двучленный binomial.
действие action, effect, operation.
держатель holder, support, base.
джоуль joule.
диаграмма diagram, pattern, chart, graph.
диск disk.
диффузия diffusion.
длина length.
дуговая печь arc furnace.

Е (е)

единица unit.

Ж (ж)

жалюзи louver.
жидкая изоляция liquid insulation.
журнал magazine, journal.

З (э)

зависимость dependence; relation(ship); characteristic.
завихрение vortex, curling, eddy.
законы Кирхгофа Kirchhoff's laws.
затвор shutter, gate, valve.
значение value, magnitude.

И (и)

излучаемость radiance, radiancy.
излучатель radiator; emitter.
излучательная способность 1. radiation capacity; 2. emissivity, emittance.
излучательный пирометр radiation pyrometer.
излучать radiate, emit, ray, beam.
излучение radiation, emission.
измерение measurement.
измерительный прибор instrument; meter.
измерять measure, meter.
изолирование insulating.
изолировать insulate.
изолировка insulation.
изолятор insulator.
изоляция insulation.
импеданс impedance.
инвар invar (nickel steel).
институт institute.
интенсивность излучения radiation intensity.
интерферометр interferometer.
инфракрасные лучи infrared rays.
испытание test(ing), probe, trial.
испытание в рабочих условиях performance test.
испытание на кпд efficiency test.
испытание на нагрев heat test, heat run.
испытательная лаборатория testing laboratory.
исследование research; exploration; examination; analysis.
источник source.

К (к)

калорифер heat radiator or dissipator.
канал 1. corduit, duct; 2. channel, link; 3. canal.
картина picture, pattern, image, figure.
касательная составляющая tangential component.
катушка coil.
каучуковая трубка rubber tubing.
квант тепловых колебаний quantum of thermal vibration.
киловатт kilowatt.
клапан valve.
колебание oscillation, vibration; fluctuation, swinging, variation.
конвекционная потеря convection loss.
конвекционный ток convection current.
координата co-ordinate.
котел boiler.
коэффициент factor, coefficient.
коэффициент излучения radiation factor, radiation coefficient.
кривая curve.
круг disk; reel.
круглая circular.

Л (л)

лак varnish, lacquer.
легкая нагрузка light load.
линия line.
логарифмический декремент logarithmic decrement.
луч ray, beam.

RUSSIAN DICTIONARY ORDER

Russian capitals:

А Б В Г Д Е Ж З И Й К Л М Н О П Р С Т У Ф Х Ц Ч Ш Щ Ъ Ы Ь Э Ю Я

Russian lower case:

а б в г д е ж з и й к л м н о п р с т у ф х ц ч ш щ ъ ы ь э ю я

English equivalents:

a b v g d e zh z ĭ ĭ k l m n o p r s t u f kh ts ch sh shch mute y mute ĕ yu ya

How to READ Heat Transfer in RUSSIAN

М (м)

максимально-возможная мощность maximum available power.
маленький мотор small motor, fractional-horsepower motor.
манометр vacuum gage; pressure gage.
масса mass.
материал material.
матрица matrix.
машина machine, apparatus.
машинный привод machine drive, mechanical drive.
мгновенное значение instantaneous value.
медный провод copper conductor.
медь copper.
мерить measure.
место place; room.
металл metal.
металлургия metallurgy.
метод method.
механизм mechanism, gear.
механика 1. mechanics; 2. mechanism, movement.
микроскоп microscope.
минеральная шерсть rock wool.
минус minus.
минута minute.
многократ multiple.
множитель factor, coefficient, multiplier.
момент 1. moment, instant (time); 2. moment (mechanical, electrical); 3. momentum; 4. feature, factor.
монтаж 1. mounting, installing, erecting, assembling, fitting; 2. wiring.
мост Уитстона Wheatstone bridge.
мотор motor.
мощность power, output, capacity.

Н (н)

набор set, kit, assembly, gang, set-up.
набрасывать (схему) sketch, figure out, draw (a diagram).
нагрев heating, warming.
нагревание heating, warming.
нагревательная плита hot plate.
нагревная проволка hot wire.
нагружать load.
нагрузка load, burden, charge.
нагрузки нет, no load.
нагрузочная способность load-carrying capacity.
нагрузочная характеристика (full) load characteristic.
нагрузочное сопротивление load resistance.
надежность reliability, dependability, serviceability.
накал incandescence.
накаленный incandescent.
наклон slope, incline.
наладка alignment, adjustment.
направление direction.
напряжение voltage.
напряженность излучения intensity of radiation.
насос pump.
насыщать saturate.
насыщение saturation.
научно-исследовательский институт research institute.
нежелезный nonferrous.
неизменное напряжение constant voltage, fixed voltage.
неизменный ток constant current.
неизмеримый unmeasurable.
несимметричный asymmetrical, unsymmetrical.
неустановившееся колебание transient oscillation.
нить 1. filament; 2. thread.
номер number.
нуклеарная теория nuclear theory.
нуклеарная энергия nuclear energy.
нуль zero.

О (о)

область region, field, domain.
обмотка winding.
обод rim.
оборот turn, convolution.
оборудование equipment, apparatus, gear.
обрыв break, discontinuity.
об/сек [оборотов в секунду] revolutions per second.
однородная проводимость isotropic conductivity.
однородное поле uniform field.
оконечная температура final temperature.
окружающая температура ambient temperature.
оксидировка oxidizing.
операция operation.
определение 1. finding, determining; 2. definition.
опыт 1. experience, test, trial; 2. experience.
орган element, unit.
осевое ускорение axial acceleration.
осмотр inspection, examination.
основание base, basis.
остирование standardization.
остировать standardize.
остов frame.
ось axis.
отверстие opening, hole, port, orifice.
отдаление distance.
отдача 1. efficiency; 2. output.
отжиг annealing.
отклонение deviation, deflection.
отличательная черта distinctive feature.
отношение ratio.
отражаемость reflectivity.
отражатель reflector.
отражательная доска ( ) baffle.
отсечка (аппарата) margin.
отсчет reading, indication; metering, registering.
отсет 1. account; 2. report.
охладитель cooler, radiator.
охлаждаемый воздухом air-cooled.
охлаждающее устройство cooler.
охлаждающий вентилятор cooling fan.
охлаждение за счет излучения cooling by radiation.
ошибка error.

П (п)

паз slot, groove.
параметр parameter.
патрубок nozzle.
первичный эталон primary standard.
переводить transfer, shift.
перегрев superheat.
передача transmission.
перестройка (кривой) replotting (of a curve).
переходный слой transition region.
периодическая periodic.
петля loop.
пирометр pyrometer.
плавиться melt, fuse.
плазма plasma.
план 1. plan, project; layout; 2. plane.
пластина plate, slab.
пластинка 1. plate (smaller or thinner than пластина), lamina, lamella, lamination, fin.
плоскость plane; 2. flatness.
плотность density.
площадь area.
площадь поперечного сечения cross-sectional area.
плюс plus.
поверхностная проводимость surface conductance.
погрешность (измерения) error (of measurement).
под давлением pressurized.
подзвуковая скорость subsonic velocity.
подогрев preheating.
подогреватель preheater.
подшипник bearing.
показание reading, indication.
показатель index; exponent.
покров cover, sheath(ing).
поле field.
полная мощность total power; aggregate capacity.
полная нагрузка full load.
полный излучатель black body.
положение position; situation.
помеха interference, disturbance.
поправочный множитель correction factor.
портативная аппаратура portable equipment.
порядок order, arrangement; sequence, course.
последовательно in series; in sequence.
постоянная constant.
построение потока flux plot.
потери loss(es).
превращение transformation, conversion.
предел limit.
прибор device, apparatus, gear; instrument.
проба test, trial, probe.
проверка testing; checking.
проводимость conductance.
производительность output, capacity, productivity.
промышленность industry.
противообледенительный anti-icing.
протокольные данные performance (data).
процесс process.
пруток rod.
прямоугольная щель rectangular slot.
пульсация (phenomenon) pulsation, ripple, fluctuation, flutter, surging.
пункт 1. point, station, post; 2. item, article, clause.

Р (р)

работа work; operation, working; performance, run.
равновесие equilibrium, balance.
равномерно-распределенный uniformly distributed.
радиационный пирометр radiation pyrometer.
радиус radius.
разгон (двигателя) acceleration (of a motor).
разгонять accelerate.
разнесенность spacing, separation, diversity.
разность difference.
разработка development, working out.
распределение distribution.
расчет design, calculation.
расширение expansion.
регулирование regulation; control.
режим regime, conditions.
резервуар tank, reservoir.
резистивный термометр resistance thermometer.
рисунок picture, drawing, pattern, figure.
ртутная лампа mercury-arc lamp.

рубашка jacket, housing.
ряд row, train, series; level; layer.

С (с)

самопрогрев self-heating.
сантиметр-грам-секундная система centimeter-gram-second system.
сборка assembly, assembling, fitting, setting (up).
сварка weld; welding.
сверхзвуковая скорость supersonic velocity.
сверхпроводимость superconductivity.
свет light.
свойство property, characteristic.
связка bundle.
связывать bind, tie, bond.
сгонная муфта pipe union
серебро silver.
сеть net, network.
сила force.
система system.
скелетная схема block diagram, simplified schematic, skeleton diagram, basic diagram.
скорость speed, velocity, rate.
слой layer, stratum, ply.
собственная частота natural frequency, free frequency, self-resonant frequency.
совершенный излучатель perfect radiator, black body.
соединение connection, connecting, interconnection, join(ing), bond(ing), junction, joint(ing), splice, splicing.
солнечное отопление solar heating.
сооружение structure, construction, edifice; plant, facility.
сопротивление resistance.
сопротивляемость resistivity.
составляющая component.
состояние state, condition.
сосуд vessel, receptacle, container.
сочленение mechanical connection.
спираль spiral.
сплав alloy.
срединное отклонение mean deviation.
средства means, facilities; resources.
срок службы life, useful life.
стабильность stability.
сталь steel.
стекло glass.
стенд stand; bench.
степень 1. degree, grade; 2. power (math).
сторона side.
стоячая волна standing wave.
строка line.
струя jet.
схема circuit, network, diagram.
счетная машина computing machine.
считывание показаний reading; plotting, computation.
счет account, calculation.

Т (т)

таблица table, sheet, chart.
тарирование calibration.
тарировать calibrate.
тело body, solid.
темнокрасный накал dark red heat.
температура temperature.
температурный детектор temperature detector.
теория theory.
тепловое действие тока heating effect of current.
тепловой амперметр hot-wire ammeter.
тепловой экран thermal shield.
теплоизлучение thermal radiation.
теплоизоляция thermal insulation.
теплообменник heat exchanger.
теплопередача heat transfer, heat transmission.
теплопроводимость thermal conductivity.
теплота лучеиспускания radiant heat.
термистор thermistor.
термистор в виде бусинки bead thermistor.
термический удар (испытание) thermal shock (test).
термическое выгорание thermal burnout.
термопарный прибор thermocouple instrument.
терморелейный мигатель thermal flasher.
термостат thermostat.
термостолбик thermopile.
термометр thermometer.
термометр сопротивления resistance thermometer.
термопара thermocouple.
термопарный пирометр thermocouple pyrometer.
ток current.
точка point; period.
точка перехода transition point.
точность accuracy, precision.
требование requirement.
труба pipe; conduit, duct.
трубопровод pipeline.

У (у)

угловя скорость angular velocity.
угол 1. angle; 2. corner.
угольная carbon, coal (of coal).
узел 1. node, junction point, branch point, vertex; 2. assembly, mounting, unit.
указание indication.
упрежденные данные predicted data.
уравнение equation.
ускорение acceleration.
установившийся режим steady state, steady conditions.
установка plant, installation, system.

Ф (ф)

фаза phase.
фигура figure, pattern, picture, drawing.
фланец flange.
форма form, shape, pattern.
форсированное воздушное охлаждение forced-air cooling.
функция function.

Х (х)

характеристика characteristic, performance curve.
ход movement, motion, run.

Ц (ц)

центр center.
цепь circuit.
цикл cycle.
цилиндрические координаты cylindrical co-ordinates.

Ч (ч)

час hour.
частица particle, corpuscle.
частота frequency.
часть part.
чередование sequence, alternation.
черное тело black body.
чертеж drawing, blueprint.

Ш (ш)

шайба термистора thermistor bead.
шар sphere, globe, ball.
ширина width, breadth.

Щ (щ)

щель slot, slit.

Э (э)

эвакуация evacuation, exhaustion.
эвакуировать evacuate.
эвапорация evaporation.
эквивалент equivalent.
экран screen, shield, blind.
эксплоатация operation, service, working.
экспоненциальная exponential.
электрический electric, electrical.
электричество electricity.
элемент element; unit, member, component part.
эмиссия emission.
энергия energy.
эрг erg.
эталон standard.
эффект effect.

Ю (ю)

юстировка alignment, adjustment.

Я (я)

явление phenomenon.
ядерная теория nuclear theory.
ядерная теория поля nuclear field theory.
ядерная физика nuclear physics.
ядерная энергия nuclear energy; nuclear power.
ядерное горючее nuclear fuel.

Prepositions

в	in, into, to, at
за	for, behind, across
для	for
к	toward
между	between, among
на	to, onto, up, to
над	above, over
о	of, about
от	for
перед	in front of
по	per, in accordance with, by
под	under, near
при	in the presence of
с	with, from, off
сквозь	through
через	across

Useful Expressions

быть	to be
было	was
были	were
будет	(it) will be
будут	(they) will be
и	and
или	or
когда	when
который	which
много	many
например	for example
некоторый	some
никогда	never
очень	very
поэтому	therefore
редко	seldom
так как	as
также образом	in this way
то есть (т.е.)	that is (i.e.)
часто	often
этот	this

In the laboratories, the study of lubrication goes forward as engineering strives to meet the new problems of high speed, high temperature, and corrosive environment.

A DIGEST OF 1957 LITERATURE

BEARINGS, LUBRICANTS and LUBRICATION

Based on a paper contributed by the Lubrication Division and presented at the Semi-Annual Meeting, Detroit, Mich., June 15–19, 1958, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS. This digest for 1957 is based principally on the Engineering Index references on bearings and lubrication.

The "Digest of 1956 Literature" on lubrication appeared in MECHANICAL ENGINEERING, vol. 79, Sept., 1957, pp. 842–852.

Boundary Lubrication[1]

COCKS [1, 2][2] studied the role of the oxidation promoted by high-speed (66 m/sec) unlubricated sliding of several metals and of tungsten carbide. Oxides protected the surfaces and gave low wear at low loads. Increased oxidation at higher loads reduced metallic tearing, though wear rate could still increase. Welsh [3] studied the wear properties of a series of soft steels of various carbon contents. In the steel-copper system at low speeds and loads, Barwell and Grunberg [4] showed theoretically and experimentally that thermal effects were negligible and are liable to be important only at severe conditions.

Flom [5] studied the transfer of radioactive silver from graphite-silver contacts to graphite and to copper cylinders. In agreement with the earlier work of Kerridge and others, metal transfer was found to occur in discrete fragments, and a limiting steady-state condition was reached in which transferred material no longer increased in amount. In another model system, Archard and Hirst [6] studied the unlubricated rubbing of hardened tool steel on itself at low load. Experimental techniques, such as radioactive tracer methods, microscopy, and electron diffraction, were applied to show that as wear progresses, wear rate increases, but the size of the wear process decreases. The influence of temperature on metallic wear was studied by Lancaster [7] for the case of 60/40 brass on tool steel over the range 20–600 C. Pigott [8] concentrated on the running-in of mild steel rubbing on itself at moderate speeds and loads.

Kozlik [9] studied the resistance to wear and galling of a variety of wrought and cast nickel-base alloys. Dewees [10] summarized the wear and friction performance of cobalt base alloys and stainless steels from a large number of tests at various conditions. This work was of interest in the development of pressurized-water nuclear reactors. Sciulli and Robinson [11] gave the details of their experiments, the results of which were included in Dewees' paper. At room temperature, wear rate increased exponentially with load and the concept of "apparent critical stress" was developed.

Flom [12] considered that the volume wear of teflon rubbing on teflon may be related to the 4/3 power of sliding distance rather than the first power, as stated earlier (Flom and Porile, 1953). Holm [13] found that the electrical resistance between a carbon brush and a copper ring fluctuated under conditions where the contact area of the ring was continually reoxidizing. This was caused by "fritting," a breakdown of the insulating film at low voltages. Halliday and Hirst [14] studied the fretting of mild steel. At large amplitudes intermetallic welding occurs at the onset of damage, and friction rises rapidly. Subsequently, it drops to a very low value.

Rabinowicz [15] developed theoretical criteria for the effectiveness of a lubricant film using a simple model. He showed that only lubricants made up of very small molecules can be energetically stable on hard metal surfaces. Dismant [16] considers friction to be a function of both plastic and elastic deformation of a metal, greater elastic properties giving lower friction.

Williams [17] has published a brief note on a theory of

[1] Report prepared by Morton Antler, Research Chemist, Research Laboratories, Ethyl Corporation, Chemical Research Div., Detroit, Mich.

[2] Numbers in brackets designate References at end of paper.

the surface friction of solids, giving a mathematical derivation of a roughness factor for a generalized model of asperities. Ling [18] used a model of one flat surface in contact with a surface having wedge-shaped asperities for a theoretical study of the actual areas of contact. He discussed the role played by the area-load characteristics in the friction process, and their relationship to the various theories of friction.

Courtney-Pratt and Eisner [19] studied the effect of tangential force on the contact of metallic bodies. Micro-displacements occur before sliding. Lubricant does not affect this deformation, but does lower the tangential force required for slip. These authors and Crook [20] agree that oxides and other protective films on metal surfaces are less disrupted in normal than in tangential loading.

Rabinowicz [21] found that a small transverse component of friction force exists. Spurr and Newcomb [22] showed that the static friction between a specimen of bituminous material and a cast-iron disk is due to adhesion between them, and that the friction is reduced when the normal load is removed because of elastic interaction between the surfaces. The same authors [23] observed that both the static and kinetic friction of a soft bituminous solid rubbing on itself decreased with increasing sliding velocity. This means creep is pronounced with this material and that friction is dependent on the lifetime of the contact areas.

Schmidt and Weiter [24] determined the static and kinetic coefficients of friction for a number of metals and plastics by experiments in which the major variables were presence or absence of lubricant, load, time at rest under load, and whether wear had occurred. Bollenrath and Grefkes [25] determined the coefficient of friction of some unlubricated alloys and steels. Sohl, Gaynor, and Skinner [26] studied the sliding of metals on plastics and lubricated surfaces and measured the instantaneous load between the surfaces, the instantaneous frictional drag, and the transient electrical potentials by an oscilloscope method.

Fraioli, et al. [27] measured the relative lubricating efficiencies at room temperature of several organic liquids and water deposited as boundary films by vapor adsorption. Miller and Anderson [28] investigated the boundary friction of steel vs. babbitt using a friction pendulum. Bailey [29] determined the resistance to shear of smooth mica sheets in the form of crossed cylinders, unlubricated and lubricated with a soap monomolecular layer.

By the method of retraction from the molten compounds or from solutions, Cottington, Shafrin, and Zisman [30] prepared adsorbed monolayers of polar paraffinic compounds and fluorinated compounds on stainless steel, measuring the friction and durability of these films. Pomey [31] reviewed the fundamentals of friction and discussed chemical treatments of metal surfaces and lubricant additives for improved load-carrying ability. White and Miller [32] formed surface coatings on titanium by anodizing in aqueous caustic or dipping in a solution containing hydrofluoric acid and dissolved salts. These coatings have satisfactory wear properties and also facilitate wire drawing and cold forming. Hugel [33] described the use of molybdenum xanthates and molybdenum blues as antiwear lubricant additives for steel.

Midgley [34] found that with thick unbonded films of molybdenum disulfide, frictional resistance decreased with increased dryness, a behavior opposite to that of graphite. Kingsbury [35] studied the wear and friction performance at high load and low speed of solid film lubricants of molybdenum disulfide or graphite baked onto a hard surface with a variety of thermosetting resins. Stupp [36] reviewed the utility of molybdenum disulfide as a solid lubricant and included data on its wear life in organic and in inorganic bonded films. Johnson, Lavik, and Vaughn [37] studied the mechanism of tungsten disulfide lubrication in vacuum. It lubricates in the same manner postulated for molybdenum disulfide (Johnson and Vaughn, 1956) by means of a surface film of amorphous sulfur formed from the compound by the rubbing action. Smith [38] in a review paper discussed solid lubricants, especially graphite and other compounds with layer lattice structures. Bisson, Johnson, and Anderson [39] studied high-temperature sliding and rolling-contact lubrication with solid lubricants.

Varanelli [40] reviewed boundary lubrication phenomena. Godfrey [41] reviewed recent Russian research on chemisorbed lubricant films and listed Russian research organizations, publications, and translation services.

Metalworking Lubrication[3]

Metal Forming. The lubrication of metalworking processes is not always viewed in relation to the particular and peculiar nature of the process. Butler [42] reviewed these special working conditions and suggested modifications to the classic theories of friction to allow for the bulk plastic flow of the work materials. During continuous deformation, such as occurs in the rolling or drawing process, the properties of the lubricant and the thickness of the established lubricant film greatly influenced surface finish. In a second paper [43], the same author used a simple plane strain compression test to study the effects of lubricants on the surface appearance of aluminum after plastic deformation. He found that the lubricant film thickness is the important factor in determining surface finish, rather than the coefficient of friction. Veiler and Likhtman [44] have published a summary of some of the ideas and results of the Russian workers, who consider that surface active constituents of lubricants modify the behavior of the surface metal of friction surfaces.

By measuring the thickness of strip produced by rolling thin SAE 1010 steel and annealed stainless steel at various speeds and with various lubricants, Whetzel and Wyle [45] demonstrated the marked effects which correct choice of lubricant can have on the maximum obtainable reduction. A study of 34 cold-rolling lubricants, ranging from pure vegetable and mineral oils to fats and emulsions with and without additives has been reported by Lueg, Funke, and Dahl [46] who reviewed previous work at the Max Planck Institute, and sought to establish a correlation between the chemical composition and physical properties of the lubricants with their lubricity and performance in cold rolling. Spiller and Funke [47] investigated the effect of roll force, rolling speed, strip tension, and the quantity of lubricant on the dimensional accuracy of cold-rolled strip. Johnson,

[3] Report prepared by N. H. G. Daniels, Metallurgist, Shell Development Company, Emeryville, Calif.

Sheeman, and Schwartzbart have proposed a cold-rod drawing test for rolling emulsions (Ref. 100, 1955 Digest). Lueg and Dahl [48] refer to this paper and from extensive trials concluded that they cannot judge the lubricating power of rolling oils by such a test.

A paper by Wistreich [49] at the London Conference on Lubrication and Wear was devoted to the physical aspects of wire-drawing lubrication. He reviewed the evidence in support of his conclusion that the regime of lubrication in "dry" drawing is quasi-hydrodynamic rather than boundary. After a short discussion of Christopherson's method of forced lubrication in wire drawing (Ref. 103, 1955 Digest), Wistreich described modifications to permit its application to the normal dry soap powder method of lubricating wire drawing.

Previous attempts to measure the die and wire temperature during drawing have not, in the opinion of Ranger [50], produced reliable data. This author measured the temperature of the outside of the die pellet, and then computed the temperature at the internal surface of the die by means of an electrical analog of the thermal system. The effect of different lubricants and lubricant carriers on the temperature in the drawing of steel wire was reported by Lueg and Treptow [51], who also measured the variation of die temperature with the length of wire drawn, the carbon content and tensile strength of the wire, and the drawing speed. Lubricants and lubricant carriers in wire drawing were also studied in an earlier paper [52] by the same authors. Siemon and Bauzenberger [53] discussed the selection of lubricants for the cold drawing of coarse and fine steel wire, respectively. An article [54] on the use of colloidal graphite in wire drawing, deals especially with the application of graphite to the hot drawing of steel wire.

BEARINGS, LUBRICANTS and LUBRICATION

Thomsen and Frisch [55] studied the extrusion of lead by observing the movement of grid lines during incremental deformation steps. The cold extrusion of unalloyed titanium [56] was successfully achieved by Sabroff, Huber, and Frost by using a fluoride-phosphate coating on the billet together with lubrication by a conventional oil-graphite-molybdenum disulfide lubricant. The use of a phosphate coating on steel billets before extrusion was also mentioned by Verson 57]. A comprehensive survey of the hot extrusion of titanium, with particular reference to lubrication, has been provided by Sabroff and Frost [58]. Greases containing solid film lubricants can give a high quality finish and close dimensional tolerances, but glass lubrication gives far better tool life. The extrusion of steel with a glass lubricant was discussed again this year by Sejournet [59] and Leclerc [60]. In the extrusion of aluminum it is sometimes desirable to use caustic lubricants. It is done by using a spray method [61] for applying the lubricant.

The choice of a lubricant for press drawing depends on the pressure, on the die and tool materials, and on the finish required. Salz [62] reviewed the five classes of additives frequently used and described the different types of press drawing lubricants. He concluded with a chart giving recommendations for various materials and severities of draw.

Although the use of phosphate coatings has become extensive in both tube and press drawing, the precise mechanism by which these coatings function has not previously been known. Midgley [63] and Midgley and Wilman [64] investigated the nature of the surface produced on mild steel by phosphating treatments. The use of a soft phosphate coating has proved much more successful than copper plating for the drawing of carbon steel rods in the USSR [65].

While the final evaluation of cold reduction lubricants can only be made on full-scale equipment, it is nevertheless necessary to screen these fluids in a preliminary manner, to reduce delays and possible damage to the mill in full-scale trials. Griffin [66] described two tests which can be used for this purpose. The cooling ability of rolling solutions was measured in a quench test apparatus.

Metal Cutting. Metal-cutting research has produced an extensive and stimulating literature this year, and lubrication has come in for its fair share of attention. A paper by Merchant [67] discussed the importance and extent of the problems of metal cutting and emphasized the need for a unified attack by physical sciences and engineering on both basic and applied research fronts.

During studies of the influence of lead in free machining steels on metal-cutting forces and temperatures, Shaw and co-workers [68] found that certain fluids that are effective on ordinary steels may interfere with the action of lead and sulfur and give poorer results than air in the cutting of free machining steels containing these elements. Sudholz [69] reviewed the fundamentals of the metal-cutting process, the nature of lubrication, the effect of cutting fluids and means of evaluating them in the laboratory. The variety of fluids available for cutting operations was reviewed by Lawson and Ellis [70] from a chemical point of view. A survey, mainly of German literature, on lubrication and cooling in metal cutting has been made by Reichel [71].

Merchant [72] in a paper given at the London Conference on Lubrication and Wear, reviewed the 20 years of progress in metal-cutting research at the Cincinnati Milling Company. He reports that the use of radioactive tool wear measurements permits much faster, more accurate, and more economical testing than conventional methods. Radioactive techniques were also described by Grindrod [73]. Some interesting aspects of the wear of cutting tools were discussed by Optiz [74]. He measured appreciable thermal-electric currents formed between the work and the tool, and found that when these were opposed by a back emf, a $2^1/_2$ fold increase in tool life could be obtained. The effects of nitrogen vs. oxygen atmospheres surrounding the tool and chip were investigated and compared with static scaling tests. Tool life was also improved by removing the cobalt binder from the carbide material of the tool in the immediate vicinity of the cutting edge.

The studies of Letner [75], reported in last year's digest, of the influence of grinding fluids upon the residual stresses in hardened steel have been extended this year by other workers. Tarasov, Hyler, and Letner [76] confirmed that chlorosulfonated grinding oils on the whole give more compressive surface stresses and lower peak

tensile stresses than soluble oils. Similar results were obtained by Haverstadt [77] for three high-temperature alloys. Clorite and Reed [78] also studied residual stresses produced during the grinding of titanium and measured from 109,000 psi tension stress to 11,000 psi compression stress. Mueller [79] also considered straight grinding oils better than soluble oil emulsions from the point of view of wheel wear and grinding ratio. A manual on the machining and grinding of titanium and titanium alloys by Olofson [80] gives recommendations for lubricants for a variety of operations.

A paper by Galloway [81] reviewed in detail the influence of various factors, especially those connected with the geometry of drilling, on drill performance. In the opinion of Petrys [82] the presence of adsorbed layers of bipolar liquids on the surface of a metal facilitates fracture along micro-cracks existing in the body of the metal, thus speeding up drilling operations. As a result of attempts to combine the reaming and burnishing of drilled holes, Collwell and Branders [83] investigated the behavior of cutting fluids in reaming steels. When the total torque stays low, as in dry reaming, a rough hole of poor tolerance is obtained without burnishing. When the torque becomes high, as with good lubricants such as carbon tetrachloride, a smooth hole with close tolerances is obtained.

The evaluation and testing of cutting fluids in a specially instrumented machine based on a drill press were described by Collwell [84]. The use of radioactive tool wear tests to evaluate cutting fluids has been described in two papers. Daasch, Eisler, McHenry, and Patton [85] compared the relative performance of three emulsifiable oils and three compounded mineral oils by the use of radioactive cutting tools. Husa [86] advised that radioactive tool wear tests by themselves are inadequate to judge oil performance, particularly if the tests are conducted at one set of conditions only. Husa and Bulkley [87], supporting this view, gave the results of radioactive tool wear rate, surface finish, and tool-chip temperature measurements on SAE 1015, 1045, and 4130 steels and AISI type 304 stainless steel, using a statistical method for planning the tests and assessing the significance of the results. Tests to determine the corrosive action of various soluble cutting oils were carried out by the Production Engineering Research Association [88]. These tests showed that stable emulsions alone cause little or no corrosion in many cases and that the corrosive action depends on the presence of chips plus emulsion. The use of coolants and cooling fluids at −40 F at the Douglas Aircraft Company has been described [89], while the special needs of abrasive belt grinding [90] and automation [91] were also considered.

Papers by Bennett [92] and Pivnick and Fotopoulos [93] dealt with the hygiene of soluble oil emulsions. The reclamation, purification, and disposal of cutting fluids have been discussed in three papers [94, 95, 96].

Automotive Lubricants[4]

General. Trends in the development of automobiles were used by Heinen [97] to point up the need for automatic transmission fluids with greater low-temperature fluidity, better heat resistance, and improved compatibility with seals; for gear lubricants of greater load-carrying capacity; and for brake fluids of increased boiling point.

The development and field testing of the new type of automotive gear oils were traced by Raymond [98]. In a thorough review, the author showed the relation between present and proposed specifications and how the new products perform in problem areas.

Wear. The relation among diesel fuel sulfur content, oil alkalinity, and wear rate was discussed by Dyson, Richards, and Williams [99]. Reporting on engine wear tests conducted in a fleet of 12 cars of two different makes, Jackson [100] concluded that about 50 per cent of the wear came from oil-born abrasives, 45 per cent from low-temperature corrosion, 5 per cent from other causes.

Loeser, et al. [101], described a cam-and-tappet test machine for lubricants, using a cast-iron cam shaft and hardenable cast-iron tappets. With this combination, zinc dialkyl dithiophosphate was effective in preventing scuffiing, even at very high loads. In a companion paper [102], it was shown that this additive increases the wear rate of both cams and tappets. The authors attributed at least part of the success of the zinc compound in reducing scuff to its ability to promote controlled wear.

Edgar [103] reviewed a number of situations in automotive lubrication where chemistry and engineering have combined to produce solutions to wear problems.

Analysis. Linnard, Threlkeld, and Blades [104] reported some data on the application of emission spectrographic analysis to the surveillance of pipeline pumping engines. Crankcase oils were analyzed for key contaminants, changes in the concentration of which may indicate various mechanical difficulties. Kniebes [105] gave details of a similar program on gas compressor engine lubrication, using both detergent and nondetergent oils, and applying emission spectrographic techniques. Lewis [106] reviewed the sources of silicon in railroad diesel crankcase oils and gave a number of examples of the application of spectrographic analysis in determining the source and degree of silicon contamination of the oil.

The "oil-spot" test was described in some detail by Courtel, et al. [107] with numerous photographs of examples to serve as a basis of comparison.

Tests. Efforts on the part of the British to use a Petter engine test instead of a Caterpillar engine to rate diesel engine lubricating oils have been unsuccessful, according to Tourret and Bale [108]; no correlation between the test results could be found. In another paper by the same authors [109], results of Caterpillar A-1 tests on oils, ranging in alkalinity from 0.9 to 5.0 total base number, were reported. These authors [110] also recommended that ring wear be determined by weight loss (after break-in). The flow of oil past piston rings has been studied in a specifically designed laboratory rig, and results were reported by Dykes [111].

A saving in fuel cost of 6 per cent was found by the London Transport Authority when diesel crankcase lubricant viscosity was reduced from SAE 30 (uncompounded) to SAE 10W (high detergent), both high V.I. type. Oil consumption increased 15 per cent, but no increase in maintenance costs was found. These tests, reported by Wilford [112], also indicate that additional savings are possible when castor-oil blends are used for rear axle lubrication.

[4] Report prepared by H. A. Hartung, Group Leader, Research and Development Department, Atlantic Refining Co., Philadelphia, Pa.

In reviewing the requirements for lubrication of small two-cycle engines, Towle [113] concluded that SAE 30 oils of moderate V.I. offer the best compromise.

Detergency. The need for better lubricants for high-speed, highly supercharged diesel engines was reviewed by Vollentine [114], tracing the development of Series 3 oils for this service. Larbre [115] discussed detergent oils, pointing out the effects of water, temperature, length and type of service, etc., on the detergency of the lubricant. Matthews [116] concluded from published data on crankcase oil deterioration that oil-insoluble products are formed from fuel soot particles.

Multigrade Oils. Withrow [117] pointed out that the claim for easier low-temperature starting is not realized with some oils, due to the fact that actual viscosity at 0 F is usually greater than the extrapolated viscosity on which viscosity grading is based.

Patterson and Gregor [118] showed that oil consumption can best be correlated with viscosity at 210 F. The viscosity to be used is the equilibrium used-oil viscosity, and the authors show how to estimate this value for multigrade oils from a knowledge of the new oil properties and the amount and type of V.I. improper present. Groff [119] reviewed the general composition and purpose of multigrade crankcase oils.

Studies of the viscosity of polymer-oil blends under varying shear rates were reported by Umstaetter [120]. The author treats the behavior of these blends according to hydrodynamic theory, and of relating the shear conditions existing in a bearing to those in a capillary.

Properties of Lubricants

Rheology. An automatic viscometer suitable for measuring the flow properties of liquid lubricants and greases under a wide variety of conditions was described by Weltmann and Kuhns [121]. The instrument is of the rotational concentric-cylinder type. A rotational viscometer and its use in measuring the low-temperature viscosities of crankcase oils was described by Hammerich and Schmitz [122]. This instrument also has cylinders of various diameters to obtain different (low) shear rates.

Criddle [123] has measured the viscosity and elasticity of surface films formed at oil-water and oil-air interfaces, using a torsion pendulum surface viscometer. Kinoshita [124] reported the results of determinations of Redwood No. 1 and kinematic viscosities on 27 oils. The author fitted his results to an equation valid for viscosities of 3 cs and higher, from 20–100 C. Saybolt Universal viscosities were similarly related to kinematic [125], and an equation for the range 70–300 F was developed for oils of viscosity 2 cs or greater.

Boelhouwer and Toneham [126] gave the results of measurement in a falling needle viscometer of the viscosities of ten fluids at various temperatures and pressures.

Other Lubricant Properties. Campbell, Pilarczyk, and Papp [127] reported on the influence of wettability of a lubricant on the friction developed in a journal bearing.

Using a magnetostrictive oscillator and an aluminum specimen, Wilson and Graham [128] have studied the effect of different lubricant properties on cavitation damage to the metal. With 11 liquids, cavitation damage decreases with decreasing density and increasing vapor pressure, and viscosity. Theoretically, cavitation damage should be proportional to the product of density times velocity of sound in the liquid; this is demonstrated experimentally to be the case.

An instrument for testing the water-separating tendencies of oils under dynamic conditions was described by Brennan and Moyer [129]. Better correlation with service requirements is claimed for this test than for the Steam Emulsion Number method and Herschel Demulsibility.

Schrock and Gott [130] presented data on the specific heat of two aircraft engine oils at temperatures down to −85 F. In another paper, Schrock and Starkman [131] gave thermal conductivity values for the same two lubricants down to −100 F. From the results of these two measurements and density determinations, thermal diffusivities are calculated. Specific heats of many liquid metals and salts were reported by Douglas [132]. Some of these have had applications as lubricants.

Cornelissen and Waterman [133] have extended some of their nomograms to give the average number of aromatic and naphthene rings per molecule from the viscosity, refractive index, and density of an oil fraction.

Greases. The flow of grease has been examined from several points of view. Milne, Scott, and Scott [134] studied grease movement in a roller bearing at low loads and speeds up to 1000 rpm. Milne [135] reported a similar study in a slider bearing, relating the observed grease flow patterns to a modified hydrodynamic equation. A progress report on the design of mechanical grease lubrication systems by Summers-Smith [136] related flow properties measured in various ways to published mathematical analyses. Evans, Hutton, and Matthews [137] related yield-stress measurements on greases and their behavior in bearings and dispensing equipment.

Synthetics. Davidson and Way [138] outlined the problems that will face future aircraft turbine lubricants. The authors visualize that some relaxation of low temperature requirements and some modification of existing lubricating systems may be necessary. Gleason [139] reviewed the properties of diester and petroleum-based lubricants at present military operating temperatures and at future projected temperatures.

Studies of more than 40 novel synthetic esters based on polyhydric alcohols were reported by Barnes and Fainman [140]. In addition to listing physical properties of these esters, the authors have included coefficient of friction data and some information on thermal stability. Two synthetic hydraulic fluids based on disiloxanes, described by Furby, Peeler, and Stirton [141], are suitable for use at temperatures in excess of 400 F.

Solid Lubricants. A discussion of solid lubricants by Smith [142] contained basic information on the mechanism of lubrication by graphite, with brief mention of a number of other solids which have been used as lubricants.

A meeting devoted exclusively to the discussion of molybdenum disulfide and related compounds was reported in brief in the German literature [143]. One of the papers in this group by Spengler dealt with the preparation of a large variety of organic molybdenum compounds, soluble in a number of different solvents. Studying the lubricating properties of molybdenum disulfide in vacuum, Johnson and Vaughn [144] showed that good lubrication persisted at pressures as low as 10^{-6} mm of Hg.

Radiation Studies. Hausman and Booser [145] summarized the problems encountered in the lubrication of nuclear power plants. Control rod drives and remote fuel-handling devices operate in surroundings of sufficient radiation level to require special lubricants.

Carroll, Bolt, and Hotten [146] described the results of a test program in which commercial and experimental greases were exposed to nuclear radiation. Greases made from inhibited alkylbenzenes, gelled with Estersil, showed markedly superior radiation resistance.

Twenty-eight industrial oils and greases were subjected to a gamma radiation dosage of $1\text{–}9 \times 10^8$ roentgens; Carroll and Calish [147] reported the changes undergone by these lubricants. Generally, the effects were similar to those of severe oxidation. An investigation into the effect of pile radiation on a number of lubricants was described by David and Irving [148], using dosages up to 1.8×10^8 neutrons sq cm.

Miscellaneous. Elliott and Edwards [149] described results of a number of bench tests on additives of different types run in the development of an extreme pressure turbine oil. Socolofsky, et al. [150] described a similar development program, with bench test and test stand results, and data on the performance of EP turbine oils in service.

Forty commercial rust and oxidation-inhibited oils were tested by Milz and Kipp [151] in two different oxidation stability tests. Lane [152] studied the problem of lubricants for friction drives, using a two-ball machine modified so that friction forces can be measured.

Godfrey [153] reviewed the theory of electron diffraction techniques and gave examples of typical patterns obtained in the study of various surfaces which may be involved in lubrication studies.

Bearings

Ball and Roller Bearings.[5] The literature on ball bearings and their lubrication during the past year reflected the current trend toward higher speeds and temperatures. The paths taken ranged from basic studies of the operating phenomena to evaluations of materials and lubrication.

Hanau [154] discussed changes in internal ball-bearing geometry at high speeds, and the design trends devised to accommodate these changes. Jones [155] outlines an analytical method for determination of ball motion and sliding friction in a high-speed thrust-loaded angular-contact ball bearing. Shevchenko and Bolan [156] studied the ball motion in a high-speed thrust bearing using high-speed camera techniques. Palmgren and Snare [157] point out that at high speed and light load there exists a hydrodynamic lubrication condition as evidenced by torque measurements.

Materials for elevated temperatures were given extensive consideration. Naumann [158] discussed the role of heat treatment in high-quality rolling-contact bearings. Blinder [159] points out the desirable properties for bearing components and the results of screening tests which suggest particular choices. Cobb [160] discussed improvements possible by vacuum melting. Butler et al. [161] present the results of a ball-spin rig which shows the variation of fatigue life with fiber orientation.

Carter [162] gives comparative life of some of the high-temperature steels. Wellons [163] presented results on the testing of bearings made from M-1 and M-10 Tool Steel.

The effect that lubricants have on fatigue life was explored. Otterbein [164] showed a correlation between fatigue life on roller bearings and bulk viscosity. Carter [165] obtained ball-fatigue data using various lubricant base stocks.

Moore and Lewis [166] suggested a possible corrosive action which affects fatigue life. Carter [167] shows a decrease in life with increasing temperature using a sebacate lubricant. Scott [168] also shows variations in life with different fluids, but differed from Carter in that solid lubricants in a fluid carrier had a beneficial effect. Eklund [169] discussed the design considerations for ball bearings in pressurized water systems, using cobalt-base alloys.

Along more general lines, Bonner [170] shows a correlation between the bearing vibration and subsequent fatigue life. Williams [171] describes a method for calculation of the stress in a bearing ring subjected to point loading. The race is treated as a continuous beam on an elastic foundation. Kloomok [172] shows how rolling-contact bearings for use as cam followers can be rated. Simpson and Russell [173] investigated the effects of magnetic fields and current flow on ball bearings.

Berg et al. [174] present methods of nondestructive testing of balls for bearings by rotation in magnetic fields, x-ray diffraction techniques, and high-frequency permeability techniques. Accinelli [175] experimentally determined some of the factors in successful operation of grease-lubricated high-speed rolling-contact bearings. Mechanical factors were dominant.

Journal Bearings and Bearing Materials.[6] An experimental investigation by Cole [176] pointed out the occurrence and significance of large variations of temperature in high-speed journal bearings. Brown and

[5] Report prepared by H. Apkarian, Mem. ASME, Manager, Bearing and Lubricant Center, and P. Lewis, Mem. ASME, Engineer, Roller Element Bearings, both at General Electric Company, Schenectady, N. Y.; and P. Baker, Project Engineer, New Departure Division, General Motors Corporation, Bristol, Conn.

[6] Report prepared by H. Apkarian, Mem. ASME Manager, Bearing and Lubricant Center, and P. Lewis, Mem. ASME, Engineer, Roller Element Bearings, both at General Electric Company, Schenectady, N. Y.; and P. Baker, Project Engineer, New Departure Division, General Motors Corporation, Bristol, Conn.

Newman [177] investigated the effect of L/D ratio and clearance ratio on oil flow, bearing torque, bearing temperature, and load capacity for high-speed, highly loaded journal bearings. Neale and Love [178] studied oil-temperature rise and oil flow through high-speed journal bearings.

Raimondi and Boyd [179] carried out numerical solutions of the fundamental lubrication equations to determine the performance characteristics of various journal-bearing configurations. Pinkus [180] also solved Reynolds equations for finite journal bearings by numerical methods. The effect of grooving with interrupted films was considered and basic equations were presented that could be used with the tables and graphs to calculate the performance of full and partial bearings.

An analytical method for the design of hydrostatic bearings was described by Loeb [181]. This method involved the use of the "Teledeltos" electric-analog field plotter to determine bearing characteristics such as film thickness, flow, and load capacity.

Cole [182] investigated the connection between film extent and half-speed whirl by the use of transparent bearings. Hull [183] reported experiments which involved a method of exciting the test bearing with a rotating force. The results showed well-defined resonances at various ratios of shaft speed to exciting-force frequency. Orbeck [184] analytically investigated the phenomenon of oil whip by considering the effects of oil film pressure forces, viscous drag forces, and centrifugal forces in a plain journal bearing. Using the short-bearing theory, a relation was established between steady load characteristics of a bearing and oil whip (half frequency whirl).

Campbell, Pilarczyk, and Papp [185] investigated a method of decreasing friction losses in journal bearings, based on the wettability conditions of a lubricant bearing combination. Needs [186] investigated viscosity variation with pressure on journal bearing performance.

Hydrodynamic gas-lubricated bearings were studied by Sternlicht and Elwell [187]. The study involved a numerical solution of the fundamental lubrication equations for finite width journal bearings, and an experimental investigation with air as the lubricant. Compressibility was considered. Analysis of hydrostatic gas bearings, by Richardson [188], took up the effects of various design parameters on the performance of compensated journal bearings.

Cole and Hughes [189] carried out an experimental program using transparent bearings and a visual inspection technique to study film extent and oil-flow characteristics with rotating load. Using a similar experimental method Ozdas [190] conducted an investigation of dynamically loaded bearings having three oil-inlet configurations. Blount and de Guerin [191] experimentally related the effects of surface finish, bearing conformity, and ambient temperature to the load capacity of heavy-duty two-stroke engine bearings.

Thrust Bearings.[7] Cole [198] concluded from an experimental investigation of various thrust-bearing types that tilting-pad thrust bearings are most satisfactory from the standpoint of power loss at high speeds. Stepped thrust bearings received interesting treatment by Kettleborough [199] and Neal [200].

De Guerin and Hall [201] found with Michell type thrust bearings that thermal effects of oil carry-over from pad to pad had a significant effect on bearing performance. The test results also reaffirmed that central pivots result in a certain loss of performance as do minute changes in pad height. A significant observation was that the pivoted pads do not tilt, and hydrodynamic film formation is the result of thermal distortion and pad deflection. These factors were subjects of papers presented by Sternlicht [202] and by Osterle and Saibel [203] and Baudry, Kuhn, and Wise [204]. Zienkiewicz [205] utilized numerical solutions to determine temperature developed in lubricating films occurring in parallel surface bearings.

To obtain a rigorous analysis of sector thrust bearings in agreement with experimental results, Sternlicht [202] showed the importance of the simultaneous solution of the Reynolds and energy equations. The effect of elastic surface deflections on pressure distribution and load capacity in hydrodynamic thrust bearings was the subject of a paper by Osterle and Saibel [203]. Mathematical solutions were obtained, by the use of a perturbation technique and an IBM 650 computer, for the two cases where the slider is considered first as rigid and of fixed inclination, and second as pivoted and flexible. The influence of load and thermal distortion in tilting pad thrust bearings was studied by Baudry, Kuhn, and Wise [204].

Pinkus [206] carried out numerical solutions for tapered-land thrust bearings. The solutions were based on isothermal conditions. A theoretical study to investigate the influence of pressure and temperature on oil viscosity and the resultant effect on the performance of finite length thrust bearings was carried out by Sternlicht [207].

A paper dealing with instability of air-lubricated thrust bearings by Licht, Fuller, and Sternlicht [208] described the results of an experimental and analytical investigation. An expression representing a stability criteria for self-excited vibrations was derived.

[7] Report prepared by H. Apkarian and G. R. Fox, Mem. ASME, Development Engineer, General Engineering Lab., General Electric, Schenectady, N. Y.

BEARINGS, LUBRICANTS and LUBRICATION

Gear Lubrication[8]

The literature on gear lubrication during the past year tended toward more adequate definition and clarification of known problem areas.

Heinen [192] discussed the new trends in automobile design which cause more stringent conditions of operation of the gears and greater demands on the lubricant.

[8] Report prepared by H. Apkarian, Mem. ASME, Manager, Bearing and Lubricant Center, and P. Lewis, Mem. ASME, Engineer, Roller Element Bearings, both at General Electric Company, Schenectady, N. Y.; and P. Baker, Project Engineer, New Departure Division, General Motors Corporation, Bristol, Conn.

Possible approaches such as run-in and gear surface treatments are given. Sands [193] pointed out the need for some reference by which the automotive industry could describe their antiscoring requirements. A reference scale was discussed.

Smalheer [194] showed that additives for hypoid gear applications can give incompatible performance characteristics when comparing a high-speed low-torque condition with low-speed high-torque condition. A combination of additives was found to meet the problem. Borsoff and Wagner [195] used a mineral oil with radioactive sulfur to determine the characteristics of the extreme pressure film. Scuffing tests [196] for the evaluation of gear oils are described in the *Journal of the Institute of Petroleum*.

Davidson and Ku [197] described test procedures for exploration of the effect of lubricants on gear-tooth surface fatigue.

Books and Reports

Books. The first volume of a set of three on the subject of rheology, edited by Eirich [A], has been published. Of particular interest to those concerned with the theoretical aspects of lubrication are chapters on fluid flow, mathematical treatment of distortion, flow behavior of high polymer solutions, the structure of fluids and colloidal suspensions, and the analysis of systems in which flow is not directly proportional to shear stress.

Three symposia on different aspects of lubrication have been published by ASTM in bound volumes. The first [B] deals with steam turbine oils, conventional and fire-resistant. The second [C] concerns the use of lubricating oils in railroad diesel engines, particularly with reference to those adapted for burning "economy" fuels. The third symposium [D] treats the subject of analysis of petroleum lubricating oil fractions.

OTS Research Reports. A number of OTS Research Reports have been made available to the public by the Office of Technical Services, U. S. Department of Commerce, Washington 25, D. C. Those pertaining to the subject matter of this Digest are listed at the end of the References.

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Abstracts and Comments Based on Current Periodicals and Events

D. FREIDAY
Assistant Editor

BRIEFING THE RECORD

Colloidal Coal in Diesel Fuel

COLLOIDAL SUSPENSIONS of irradiated coal in diesel fuel are being experimented with by the Denver & Rio Grande Western Railroad. The road has been particularly interested in coal since it is one of the largest commodities hauled—6.8 million tons out of a grand total of approximately 21 million tons.

A paper presented by Ray McBrian, Mem. ASME, director of research for the D&RGW Company, at the 1958 Coal Convention of The American Mining Congress, describes the research. The author states that it is purely exploratory and experimental in nature, but offers great promise for the use of solid fuels such as coal for almost any type of internal-combustion engine.

While investigating the possibility of improving or securing fuels which would be of lower cost than nuclear fuel itself, the D&RGW became interested in the work of Irving A. Berger of the U. S. Geological Survey in radiating lignite coal and upgrading it into a similar bituminous-type fuel. In an oral paper before the 1957 Gordon Research Conference on Coal, he stated, "In summary, exposure of the coal specimens to integrated fluxes of slightly over 2×10^{19} slow neutrons per sq cm led to noticeable changes in carbon content of the samples. The higher-rank coals, such as anthracite and low-volatile bituminous coal, lost carbon gradually during exposure. Lignite and sub-bituminous coal lost carbon during early stages of irradiation and then showed increases in carbon content. Most changes were of the order of about 2 per cent carbon. In the case of humic acid a linear increase in carbon was noted, this increase amounting to some 7 per cent. Similar data have been accumulated relating irradiation with fixed carbon, volatile content, oxygen content, and Btu values. The data have also been evaluated in an attempt to determine the radiochemical mechanisms responsible for the changes observed. In general, demethanation and decarboxylation appear to be the most likely mechanisms, but losses of methane and carbon dioxide do not necessarily occur simultaneously.

After visiting Dr. Berger, the D&RGW decided, to investigate the effect of radiation upon coals in their own territory. This was based upon the use of the electron microscope in evaluating the petroleum types of fuel which were found to be colloidal in nature. It was also remembered that Rudolph Diesel himself had intended the diesel to burn coal but was never able to successfully accomplish this because of the fact that he could not secure proper particle sizes.

The coals in the railroad's territory were high volatiles with a typical analysis of 12,500 to 13,500 Btu per lb, 38 per cent volatile, 50 per cent fixed carbon, 8.9 per cent ash, 0.08 per cent sulfur. The coal was ground to 250 mesh, placed in tin cans, sealed, and then exposed to various types of radiation.

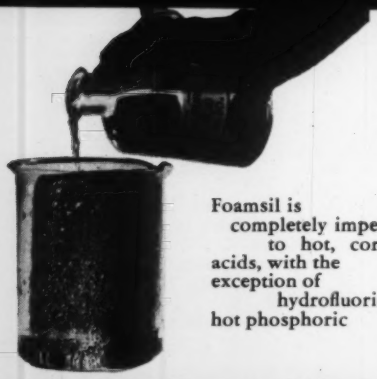
The coal-irradiation studies were made at Brookhaven National Laboratory with coal alone and with coal-oil mixtures. The total radiation in roentgens varied from 1.8 million to 24 million. The time of exposure varied from a few hours to 24 hr. Radiation intensities varied from 250,000 to 1 million roentgens per hr. All fuels were then evaluated by the use of electron-microscope techniques.

The railroad is still experimenting with various dosages, the geometry of the fuel, the storage type of radiation and of catalysts, and coal combustion. A small 5-hp Witte diesel engine has been run on irradiated coal in a No. 1 distillate. The engine ran satisfactorily combustionwise for approximately $\frac{1}{2}$ hr. The output was comparable to that obtained with regular diesel fuel. One item noted, however, was the tendency of the cooling-water temperatures to rise slightly during the burning of the coal and oil mixture.

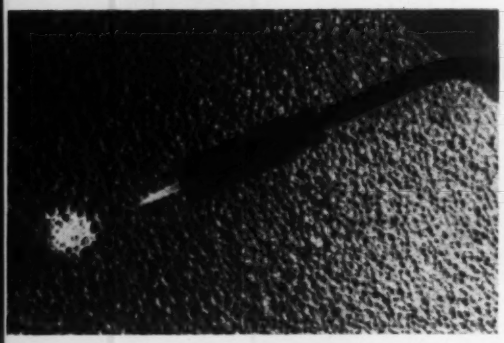
Electron micrographs showed that 1 to 4-micron-particle-size coal was split by irradiation, making it on the order of the same particle size as conventional petroleum fuels.

Continuing studies have shown that through the use of some catalysts better particle size of the mix can be secured, and indicate that the coal is going into solution. Generally speaking, the theory is that coal is composed of saturated and unsaturated hydrocarbons, heterocyclic compounds containing oxygen, nitrogen, sulfur, and aromatic compounds. The aromatic compounds are the primary constituents. In general, irradiation will result in degradation of the constituents of coal, resulting in turn in a decreased particle size. These particle sizes are on the order of $\frac{1}{2}$ to 1 micron size. Since the Btu content of a pound of coal and a pound of fuel oil are about the same, the burning of 10 per cent coal in 10¢ diesel fuel would be equivalent to 1-cent-a-gal savings for the 10¢ diesel fuel. If this percentage can be increased then of course the savings are increased. The first aim is to use the 10 per cent mix. Burning an average of 5 million gal or 40 million lb of diesel fuel per month, the 10 per cent mix could mean 4 million lb of coal to be used. This percentage then would be increased if a way could be found to secure more coal as colloidal material mixed with oil.

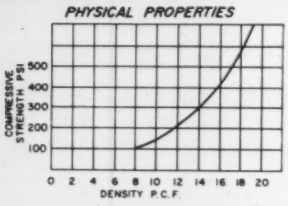
Acid-Resistant Refractory and Insulator

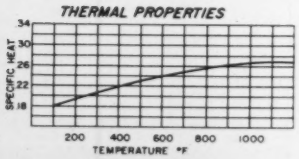


Foamsil is completely impervious to hot, corrosive acids, with the exception of hydrofluoric and hot phosphoric



When subjected to an oxyacetylene torch and water-quenched, Foamsil does not crack or spall





Foamsil is installed in an aeronautical test chamber, where temperatures are maintained from −100 to +1200 F

Foamsil may be readily cut and shaped with knives or saws

THE Pittsburgh Corning Corporation, Pittsburgh, Pa., has succeeded in causing pure silica to boil and foam, and in so doing has created an entirely new acid-resistant insulating and refractory material.

The material has a wide range of applications in the chemical and chemical-process industries as well as many areas of the metallurgical, electrical, electronic, nuclear-energy, petroleum, petrochemical, and aeronautical fields.

Concrete, brick or steel stacks subjected to corrosive atmospheres may be readily lined with the lightweight acid-resistant material. It can likewise be used as underground thermal and electrical insulation.

The new material, called Foamsil, is 99 per cent pure fused silica and can neither oxidize nor absorb moisture. It is unaffected by all acids, with the exception of hydrofluoric and hot phosphoric.

The material offers continuous insulating protection and withstands thermal shock within the range of −450 to +2200 F. The insulating value of 1 in. of Foamsil is equivalent to that of 18 in. of acid brick at an operating temperature of 250 F. The temperature range according to the company is greater than that for any other insulating or refractory material.

Foamsil is now being produced in quantity at the company's Sedalia, Mo., plant.

The pure silica, activated by a foaming agent, foams into millions of tiny, noninterconnecting bubbles resulting in a lightweight, rigid, inorganic block, with a closed-cell structure, when cooled.

The dimensional stability of the material is exceptional. It does not warp, shrink, or slump during rapid temperature changes. When subjected to intense heat, such as that of a steel-cutting oxyacetylene torch and then water-quenched, it does not crack or spall.

A low expansion coefficient of 3.5×10^{7}, about $^{1}/_{18}$ that of low-carbon steel, gives the material volume stability throughout its entire temperature-operating range. Foamsil actually expands at temperatures up to 2200 F, whereas most insulations shrink. It has been heated in a furnace at 1600 F for more than 2 yr without any evidence of deterioration. This feature reduces the need for expansion joints and vertical clearances, and virtually eliminates joint separations due to expansion and contraction. Flexural strength is 120 to 150 psi, modulus of elasticity 200,000 psi.

Weighing only 10 to 12 lb per cu ft and having a compressive strength of 130 to 210 psi, Foamsil can be used as a load-bearing surface to eliminate some of the supporting and reinforcing structure required with conventional material. It should be protected against caustics and abrasives.

The material is available in block sizes—11 × 17 in., 17 × 22 in., in thicknesses up to 3 in. Greater thicknesses may be obtained by laminating. Approximate cost of the material is 50¢ per board ft.

Laboratory and industrial applications show Foamsil to be ideal as a lining inside tanks and pipelines that contain hot acids of any concentrations. The sealed silica cells prevent absorption of the acids, inflammable solvents or vapors, thus assuring full original insulating value throughout the life of the equipment it serves Because of the absence of capillary action, Foamsil also cannot act as a wick for transfer of inflammable liquid or gas to critical areas.

Indian Point Vessel Closure

WHAT is believed to be the largest, thickest, and heaviest pressure-vessel closure ever made at a single stroke by die-forming was recently completed at The Babcock & Wilcox Company's Barberton, Ohio, works. The closure will become the bottom head of a nuclear-reactor vessel which will generate steam for electricity at the 275,000-kw Indian Point, N. Y., station of the Consolidated Edison Company of New York, N. Y., scheduled for operation in late 1960.

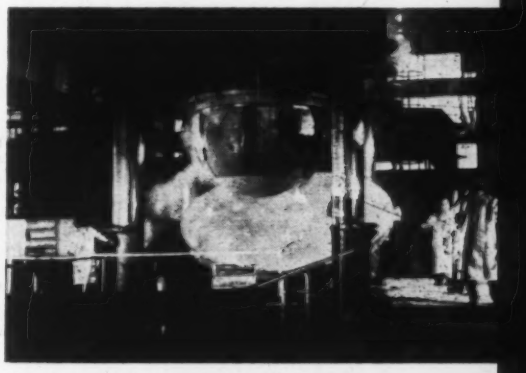
Babcock & Wilcox has the contract for basic nuclear engineering, research, and development for the project, and will furnish the major items of nuclear equipment, including the reactor vessel.

The head was pressed from a 58,646-lb flat, circular plate of 70,000-psi-tensile-strength SA 212 Grade B carbon-silicon steel, 15 ft in diam and $7^{13}/_{16}$ in. thick. Before forming, the plate surface which was to become the inside of the head was clad by a patented B & W process with a 0.109-in. layer of AISI type 304 stainless steel.

To make the plate workable, it was heated approximately 6 hr to bring the temperature to 2000 F. It was then positioned between a 70-ton male die and a female die ring, supported by a 70,000 psi-tensile-strength cast-steel die holder, on the 6500-ton vertical hydraulic press. The die setup, specially fabricated by B & W, weighed 140 tons.

A force of approximately 3300 tons was exerted to form the plate into a hemispherical-shaped head with an OD of 11 ft $^5/_8$ in. and an ID of 9 ft, 9 in.

Further steps in the fabrication process involve heat treating, testing, drilling holes for water-inlet and control-rod nozzles, and welding the nozzles to the head. A bevel was machined on the head rim prior to welding it to the shell of the reactor vessel by the submerged-arc process. All welds are subject to a rigid radiographic inspection procedure, as well as other nondestructive tests. One of the final operations calls for a hydrostatic test of the head, when it has been joined to the reactor shell, under a pressure equal to $1^1/_2$ times the designed operating pressure.



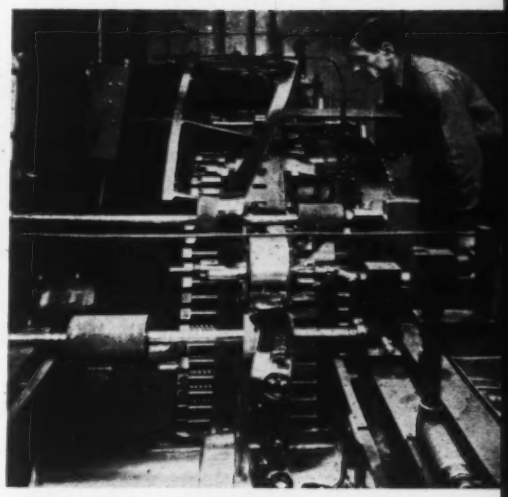
Steel slab for the pressure-vessel head is moved into position between dies

Continuous Molding of Rubber

THE FIRST fully-automated continuous process for custom molding of rubber parts is in production at the Stratford, Conn., plant of The Ohio Rubber Company, a division of Eagle-Picher Company. Each part is formed in a self-registering, single-cavity mold, which permits routine tolerances of ±0.005 in. and in some cases ±0.002 in. These compare favorably with the best tolerances established by the Rubber Manufacturers Association. Because of the high degree of mechanization, costs are no greater than those of conventional molding methods. The process can be used to mold most rubber and synthetic-rubber compounds.

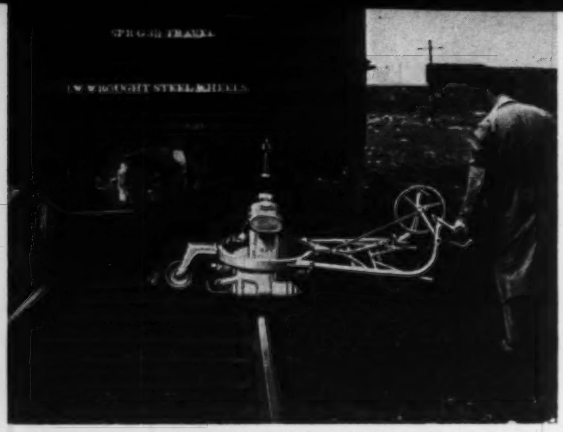
An operator is required only to keep the machine supplied with compounded stock and to remove containers of finished parts. He loads stock onto plasticizing rolls, from which it is automatically fed into the rotary-molding portion of the machine. Individual molds mounted on a rotating wheel automatically take the amount of material they need, carry it through the molding and curing stages, discharge the finished part, and return for more stock, in a continuous cycle. Molding time, temperature, and pressure are all under precise automatic control. One machine can produce from 40,000 to 200,000 pieces per day, depending on the material and the size of the piece. Under special circumstances, production rates can be substantially higher.

With present methods and equipment, the continuous automatic molding process is best suited to relatively small parts, required in large quantities, which are functional and therefore require a significant degree of dimensional accuracy and quality of material. Quantities of a million or more pieces annually will be required in most cases to amortize the tooling costs. Maximum dimensions with present equipment are normally approximately $1^1/_2$ in. in diam, and 1 in. in thickness. Larger pieces can be molded if lower production rates are acceptable.



Continuous automatic rubber-molding machine with plasticizing mill in foreground and rotary-molding section in background

Typical of parts for which the new process has been found ideally suited are precision seals for automotive shock absorbers and universal joints, engine valve-stem deflectors, washers for water conditioner quick-connectors, and electric condenser caps. Most of these parts were formerly produced by precision compression-molding methods because of their dimensional-accuracy requirements, and are now being made with equal or greater accuracy, and at substantially lower cost.



A 100-ton railroad car can be moved by one man with a single-wheel single-cylinder device which has three dial-selected forward speeds.

One-Man Railroad-Car Mover

A SINGLE-WHEEL, single-cylinder device is now available in this country for shunting railroad cars in and out of sidings. Called the ILO Single-Wheel Car Shunter, one man can move any car up to 100 tons at normal walking speeds.

The shunter is intended for use in railroad yards, marine harbors, and on the sidings of warehouses and manufacturing plants where cost of a small switch engine is not justified or where cable pullers do not satisfy needs for versatility. One of the big advantages of the Car Shunter is its ability to travel anywhere in the yard—on or off the tracks. The large rubber tire has special gripper teeth to pull the Car Shunter over rail points, switches, sleepers, and ties without damage to them or the Shunter.

Car engagement is provided by a high-ratio jack screw and clamp. Cars can be released at coupling speeds for train make-up.

Three dial-selected forward speeds are available. The carriage swivels 90 deg in either direction so that the shunter can get in between coupled cars, and so that the operator can walk adjacent to the tracks for safe visibility. The shunter follows the rail automatically; the operator is required to control only the throttle.

The unit weighs only 550 lb. Center of gravity is under the axle for easy maneuvering.

Over 3000 of the units made by ILO-Werke, a division of Rockwell Manufacturing Company, are already in use in Europe. Distribution is now being established here by Arnold A. Kosarin and Associates, Detroit, Mich.

Largest Tandem-Compound Turbine

A 325,000-kw tandem-compound quadruple-flow turbine driving a single generator rated at 384,000 kva has been ordered from the Westinghouse Electric Corporation by the Arkansas Power and Light Company.

Steam conditions for the 4-cylinder, 3600-rpm turbine are 2000 psig, 1000/1000 F and exhausting at 1 to $1^1/_2$ in. Hg abs. This unit, including its innercooled generator, is approximately 125 ft long. The largest tandem-compound unit on order in the world, it will be delivered in 1960.

By the combinations of four 25-in-long low-pressure blades in two tandem double-flow, low-pressure ends, it is possible to obtain ratings up to 350,000 kw.

The h-p element is of the opposed-flow construction. The i-p element is of the double-flow principle with high-temperature features and provision for special rotor cooling at the center inlet of the machine. Because of the high volumetric flow, two openings are provided in each end of the i-p turbine cover. Steam from these four openings flows through two crossover pipes into two double-flow, l-p turbines.

Sulfur Mine Under Water

SULFUR will be mined seven miles offshore in the Gulf of Mexico in a unique operation by Freeport Sulphur Company. A gas turbine and compressors will supply air, power, and hot water to bring sulfur to the surface.

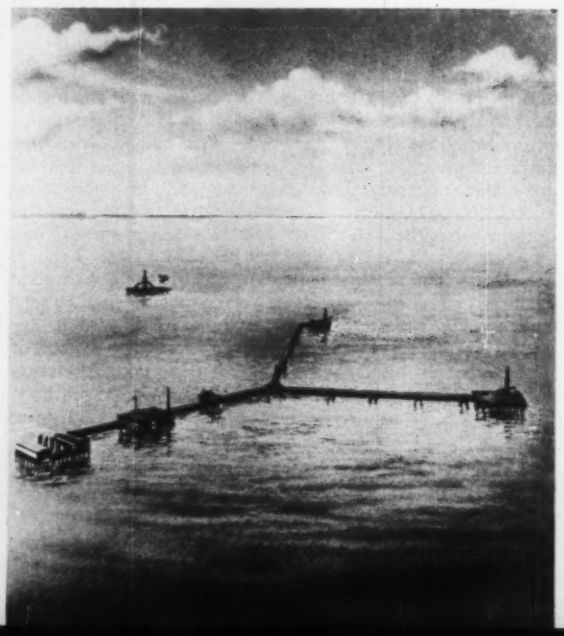
The deposit to be mined lies approximately 2000 ft beneath the floor of the Gulf in 50 ft of water. The power plant and other mining facilities will be mounted on a huge platform interconnected with other platforms at the "wellheads." Machinery will include three CMA-4 air compressors, rated at 350 bhp, and a Mark TA, 800-kw gas turbine built by Clark Brothers Company, one of the Dresser Industries.

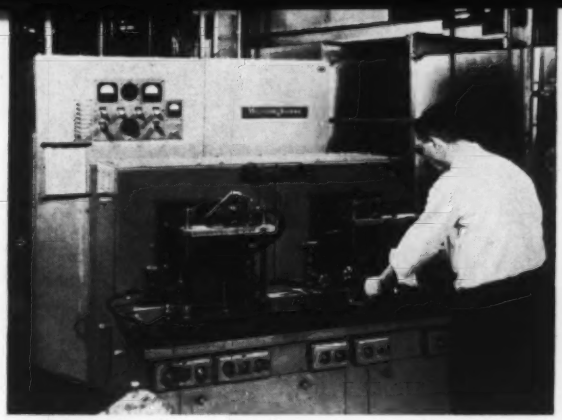
The Clark gas turbine is directly connected to a generator which furnishes power to run the machinery, including the Clark compressors. Waste exhaust gas from the gas turbine is used as preheated boiler combustion air to help heat 5 million gal of water a day at 325 F.

The water heated by the turbine-exhaust gas and air from the compressors at a maximum pressure of 1000 psig will be used in the Frasch process mining of sulfur. The outer of three concentric pipes carries the hot water to the sulfur deposit; the inner pipe carries the compressed air down into the well, and the intermediate pipe carries the column of molten sulfur which is forced to the surface by the compressed air.

The CMA-4 compressors being used are motor-driven and feature the exclusive Clark balanced-opposed design which virtually eliminates vibration making these units ideal for offshore-platform use. They are built in sizes ranging from 75 to 5000 bhp. Clark Mark TA gas turbines generate up to 9500 lb of low-pressure steam per hr from exhaust gases which contain up to 10 million Btu per hr of recoverable energy at 870 F.

Sulfur will be mined seven miles offshore in the Gulf of Mexico from a deposit 2000 ft beneath the floor of the Gulf in 50 ft of water. Power plant and other facilities will be on interconnected platforms.





Automobile parts are radio-frequency hardened in a semiautomatic operation requiring only manual loading and unloading

Radio-Frequency Hardening

EQUIPMENT for radio-frequency hardening of automobile parts has been installed for automotive-parts manufacturing. Built by the Westinghouse Electric Corporation, this equipment is one of a series of automatic and semiautomatic tools engineered to solve a hardening problem.

For this particular application—induction hardening of the internal spline of a universal-joint yoke—Westinghouse has supplied a 50-kw, 450-kc radio-frequency generator, a dual-position worktable, two lift-rotate spindles, and special fixtures.

The r-f generator and its associated output transformers located in the worktable supply the concentrated power necessary for high-speed surface hardening.

The dual-position worktable houses the lift-rotate spindle and special fixtures, and incorporates control circuits to integrate this work-handling equipment and the r-f generator. The lift-rotate spindle imparts linear as well as rotary motion to the work.

The entire operation is semiautomatic, requiring only manual loading and unloading of the work. In the process-operating cycle the operator loads a part to be hardened into a fixture at one station, and presses a button that sets the machine in motion and applies r-f power to the inductor. He loads a part into the other fixture, and starts this station with another push button.

In the first station, the work is lifted into a solenoid-type inductor where the internal spline surfaces are heated to hardening temperature and is then lowered over a quench tube for spray quenching. Uniformity and concentricity of the case depth is assured by position guidance and rotation of the work during this heat-quench. When heating in the first station is finished, power is automatically transferred to the second station.

During the entire process, the operator handles only two controls—the start-stop push button for each work position. All other adjustments including any particular heat cycle are preset.

New Notch-Toughness Test

A MORE effective way to measure and rate toughness of tool steels has been developed by Crucible Steel Company of America, Pittsburgh, Pa., and was recently presented at a meeting of the American Society of Tool Engineers. The Company said industry-wide adoption of this method would fulfill the need for a single standardized procedure of rating toughness of tool steels heat-treated to high hardness.

The new testing method involves a change in the preparation of the specimens tested rather than a change in testing apparatus. By abandoning the standard V-notch on the specimens and replacing it with a cylindrical notch of $^1/_2$-in. radius, a greater spread in impact value was obtained for different hardened tool steels in the conventional Charpy-impact tests.

The simple and relatively inexpensive process provides several distinct advantages over the conventional methods. It differentiates between the impact strength of various steels and establishes the heat-treatments which result in optimum toughness of the individual steels. It also enables the testing to be conducted in the temperature range in which the steel is ordinarily used.

After extensive testing of numerous tool-steel specimens with various notch radii and under varying temperatures, Crucible's research metallurgists concluded that the most suitable notch is one measuring $^1/_2$-in. radius.

The $^1/_2$-in-notch radius provided the maximum spread of impact resistance obtained by testing different tool steels heat treated to essentially the same hardness. At the same time, the $^1/_2$-in. radius allows for testing within the range of existing impact testing machines. With some tool steels, for instance, the energy required to break the test piece with a $^1/_2$-in. notch radius exceeded the capacity of the Charpy-impact machine resulting in experimental failure and probable damage to the impact machine.

High-Temperature Strain Gages

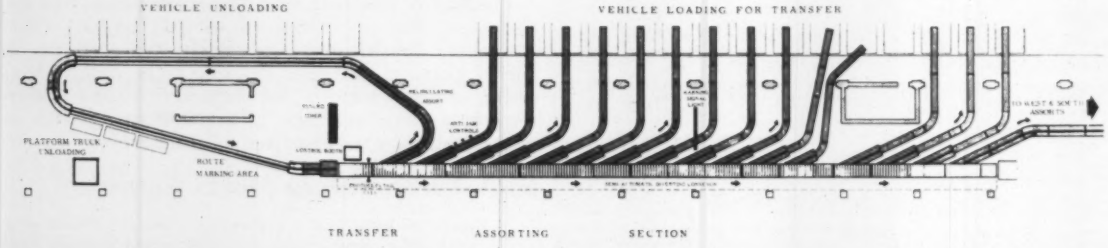
A PROGRAM aimed at improving existing strain gages and developing new types for high-temperature use is being carried on in three laboratories at the National Bureau of Standards under the sponsorship of the Navy, Air Force, and Atomic Energy Commission. The work includes the improvement of ceramic-bonded gages, the development of strain-sensitive evaporated-film gages, and the evaluation and calibration of presently used, and proposed strain-measuring devices.

At present, gages are urgently needed to perform satisfactorily up to 1000 F, and in the near future instruments for use up to 2000 F will be in demand. The NBS is attempting to modify the usual type of resistance strain gages for high-temperature applications through the use of ceramics in the place of organic cements. A second approach would eliminate cements altogether by employing directly deposited metal or alloy conducting films instead of attached wires. Electrical contacts bonded to the test surface at either end of the film would permit strain measurements.

A new commercially available ceramic-bonded gage developed by the NBS and designated the 5B design gives usable static-strain data up to 800 F. The NBS has also developed equipment and procedures which are now available for the comprehensive evaluation of gages up to 1000 F.

No gage as yet developed is entirely suitable for use at elevated temperatures. However, work on the improvement of existing gages and the development of new gages promises to extend measurements into the high-temperature region. In the meantime, a knowledge of characteristics of presently available gages as provided by the NBS evaluation center, may make possible meaningful strain measurements at intermediate temperatures.

As marked packages move past the viewing booth, the operator depresses corresponding keys. Photoelectric eyes simultaneously measure package length, and the information is relayed to a memory wheel in a synchrotimer. This later activates the proper number of steel "boots" to divert the package at the proper lane.



Railway Express Assorter-Conveyer

A NEW high-speed "electroautomated" assorter-conveyer which can separate packages of all sizes and shapes to 15 different distribution points is in operation at Railway Express terminal facilities in Long Island City, N. Y., the company's largest facility in the U. S.

The 180-ft-long 3-ft-wide machine has been integrated into the terminal's main powered-conveyer line to help further speed the handling and distribution of express shipments through the metropolitan area.

Equipped with electromechanical controls the semi-automatic assorter-conveyer operates at speeds from 100 to 300 fpm and can handle 3000 individual packages an hour. It is powered by a 15-hp parallel-drive variable-speed gear-head motor and 16 1/3-hp right-angle gear-head motors.

Designed and custom built to the agency's specifications, the new materials-handling unit was developed by Nelson Laboratories, Hyattsville, Md., and Railway Express engineers.

Packages going to various destinations are placed on a powered belt conveyer and move into a marking area where each piece is marked for a specific separation point according to its destination. Marked shipments then enter the electroautomated assorter-conveyer area and move past a viewing booth which houses an operator and an electronic control box equipped with a lettered keyboard similar to that of a typewriter.

As packages move by the booth, the operator depresses an appropriate key on the control box which corresponds to the mark on the package. Photoelectric eyes which flank the assorter-conveyer just beyond the booth then measure the length of the package and relay a signal to a memory wheel in a synchrotimer device.

At a synchronized time the memory wheel activates the exact number of triangular-shaped steel fingers that will be needed to guide the package down the assigned distribution line. Each steel finger is fastened to the end of a slat slide which moves continuously with the conveyer.

Shipments are propelled down auxiliary-powered and gravity rollers to platform edge and loaded into trailers for transport to other terminals for delivery and transfer.

To help insure a smooth continuous flow of traffic the assorter-conveyer is equipped with automatic signals which sound an alarm when any auxiliary conveyer finger is about to be filled. A recirculating arrangement automatically diverts packages refeeding them into the assorter-conveyer area until a finger is available.

Peak-Load Gas Turbine

A 20,500-KW gas turbine specifically designed for low-cost peaking is being offered to electric utilities by General Electric's Gas Turbine Department.

Available for gas or distillate-oil fuels, the new unit is equipped with a high-flow compressor and is suitable for operation at 1600-F firing temperature.

The new unit is developed from the 16,500-kw, simple-cycle, single-shaft gas turbine with combustion and turbine, and modifications. At 1600-F firing temperature the rating is 20,500 kw, 13,800 volts.

A postwar development, General Electric gas turbines have accumulated more than 2,500,000 hr of operation in just nine years to set an industrial milestone.

Electronic Ear Mufflers

THE Department of the Army and the Radio Corporation of America have developed silence synthesizers designed to create artificial quiet amid the roars of combat.

The new experimental earphones, considered a major break-through in noise reduction, shut out loud noises that interfere with vital combat communications, and are expected to have many commercial as well as military uses. For example, they could be worn by riveters and mill workers where the roar of machinery is not only a nuisance but sometimes a menace. Developed by the U. S. Army Signal Research and Development Laboratory, Fort Monmouth, N. J., and RCA engineers in Camden, N. J., the earphones are expected to find wide use in tanks and Army planes.

Paradoxically, the scientists created the artificial quiet by adding more noise. A miniature microphone in the special earpiece creates a second noise—just as loud, but opposite in phase. When the two sound waves meet in the earcup, they use up most of their energy fighting each other. The result is a greatly reduced noise level. A loud roar is muffled to a whisper.

The earpieces work in conjunction with a special electronic inverter and amplifier unit that in large-scale production could be made small enough to fit into a soldier's pocket. The electronic system cuts low-pitched sounds down to as little as one-tenth their original volume. Higher pitched sounds are trapped by special foam cushioning.

Heat-Pump Installation

THE third largest heat-pump system in the United States is heating and cooling Washington Water Power Company's new buildings at Spokane, Wash., efficiently and economically. The report was made by J. A. Wright, Washington Water Power Company engineer, in a paper, "Centrifugal-Heat-Pump System for Service Center," presented during the 1958 Pacific General Meeting of the American Institute of Electrical Engineers.

Principal components of the heat-pump system are two centrifugal refrigeration units. The first, a 285-ton unit, was installed in 1956. The second, a 530-ton unit, was installed this year. Water from an underground river is the heating and cooling source for the system. The water temperature varies only 3 deg throughout the year, ranging from 49 to 52 F. A stand-by oil-fired boiler also is included.

Spot checks on the 250-hp heat pump have indicated the coefficient of performance to be 4.5. This means that for every kilowatt hour used in operating, including well pump and auxiliary equipment, heat is available to the buildings in the equivalent of 4.5 kwhr.

With rated motor efficiency of 92 per cent, the cost for running the two heat pumps full load for one hour under the rate filed for this type of load is $3.661. Based on total specified output of 9 million Btu per hr at full load, this results in a cost of $0.407 per million Btu at the heating-supply header. This compares with a cost of $1.20 per million Btu at the heating-supply header for fuel used in the oil-fired boiler. This is based on $5.30 per barrel of Bunker No. 6 P. S. 400 delivered, and assumes 70 per cent plant efficiency.

The small heat pump has operated through two heating seasons and one cooling season during which it supplied adequate heating and cooling for the service building and garage. Lowest official temperature in Spokane during that time was −18 F. Highest was 96 F.

Since the other two buildings were completed this summer, there is no operating experience for the total combined load, but from observed performance of the smaller heat pump, which was better than design, it is anticipated that there will be considerable margin over the design performance for the entire heat-pump system.

Nuclear Briefs

▶ Argonne Fuels-Technology Center

CONSTRUCTION has begun on a 182,000-sq-ft Fuels Technology Center at the Argonne National Laboratory, Lemont, Ill.

The center is expected to enable Argonne scientists to speed up and expand their efforts to develop technology to permit use of plutonium as a fuel in nuclear-power reactors. The potential economic importance of plutonium as a nuclear-reactor fuel arises from the fact that it can be made from uranium-238, which is relatively plentiful. Although nonfissionable in its natural state it can be converted to fissionable plutonium.

The special shop for the fabrication of fuel elements which is now being done in temporary facilities has been constructed and is scheduled for operation early next year.

The knowledge of the peaceful potentialities of plutonium has been limited because most of the research on this element stemmed from weapons needs.

Construction of the substructure, site work, and underground services was by Darin and Armstrong, Inc., Detroit, Mich. Singmaster & Breyer, Inc., New York, N. Y., will perform the architect-engineer functions.

▶ Commercial Radiation-Detection Service

Radiation detection is available as a commercial service from Nuclear Science Engineering Corporation, Pittsburgh, Pa. The unusually sensitive methods employed permit quality control on an unprecedented level in the manufacture and processing of chemical catalysts, metals, metal products, alloys, and many other products in which trace elements in small quantities can be used for control.

The method will determine, for example, the presence of 1 part per billion of boron in silicon, or the presence of 1 billionth of a gram of uranium in a mineral sample, and in some cases as little as 1 part per 100 billion can be detected.

▶ Aircraft-Propulsion Development Reactor

The National Advisory Committee for Aeronautics will build a 60-thermal-mw reactor at the Plum Brook Ordnance Works near Sandusky, Ohio, to further development of reactors suitable for aircraft propulsion. The $10,735,000 light-water-cooled-and-moderated reactor will be enclosed in a 9-ft-diam × 32-ft-high and stainless-steel-clad vertical-cylinder pressure-vessel tank.

Turbodrill is used at Moran Drilling Company's Rig. No. 14 in Herscher, Ill., for very hard formations.

1 Vibration Effects. Severe vibrations can be simulated with frequencies up to 2000 cps and amplitudes of 25 g on this test facility at the U. S. Gauge Division of American Machine and Metals, Inc. In addition, ambient temperatures can be controlled from −80 F to +500 F. Effects can be observed with automatically synchronized high-intensity stroboscopic light and a X 10 stereomicroscope.

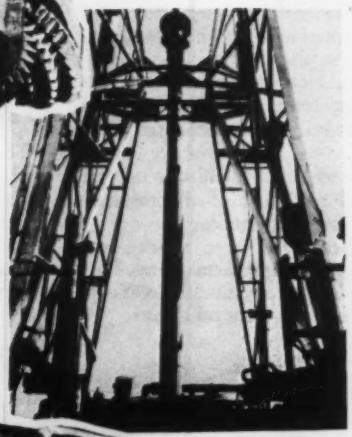
2 Pipe Straightener. Oil well casing is straightened on this nine-roll Blaw-Knox Medart straightener. Cross roll pressure exerted by the clusters is positively limited by a pneumatic pressure device.

3 Bridge Sheaves. One of eight 60,000-lb cast-steel sheaves for the world's longest vertical lift bridge being built for a B & O railroad subsidiary between Staten Island and New Jersey has 10 grooves each 1 3/16-in-deep × 2 3/16-in-wide machined into it on a 20-ft vertical boring mill. Blaw-Knox Company cast the 16-ft-diam sheaves which will carry 2¼-in. wire rope to raise and lower the 558-ft-long span.

4 Flying Through Fog. Simulated images of the horizon, the outline of obstacles, and the earth below on a pilot display reduce the hazards of flying through fog. The device was designed and developed by the Autonetics Division of North American Aviation, Inc., for Bell Helicopter Corporation.

5 Transmission Checkouts. This multipurpose testing unit developed by Consolidated Diesel Electric Corporation, Stamford, Conn., scientifically checks out all popular-make automotive transmissions. For use by engine rebuilders and fleet operators of taxis, trucks, and buses it can drive a transmission through a wide range of settings up to 4500 rpm. Load torques can be hydraulically applied up to 300 in-lb. Transmissions can be serviced while on the machine, and can be swung 90 deg, on center, for adjustments.

6 Zirconium Heat Exchanger. An 11½-sq-ft heat exchanger fabricated by the Pfaudler Company, Rochester, N. Y., has solid zirconium bonnets and tubes, and zirconium-lined tube sheets. The 4½-in-ID shell is constructed of polished type 304 stainless steel. All welding was done in an argon atmosphere. Corrosion resistance of zirconium makes it especially suitable for process-industry use. Bonnet heads were formed by pressing to ASME code dimensions on a hydraulic press.



Turbodrill.
Dresser Industries Turbodrill makes hole up to 10 times faster than rotary drills, uses fewer bits, reduces hole deviation to zero, and is remarkably free of troublesome "fishing." The circulation fluid is also the source of energy, and 13,000 ft of drilling experience has been acquired in the past two years.

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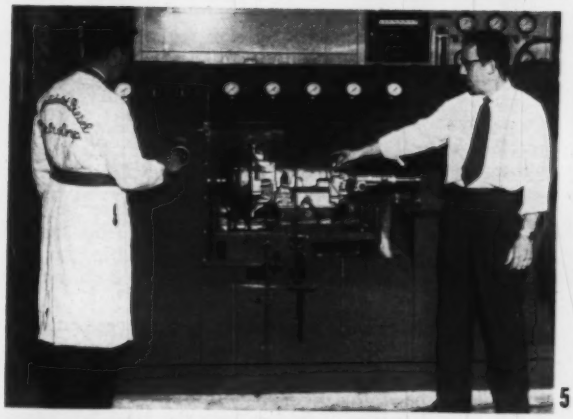

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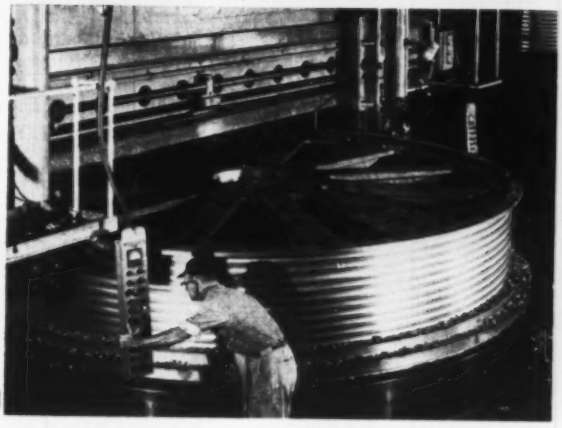

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Engineering Progress in the British Isles and Western Europe

J. FOSTER PETREE
European Correspondent

EUROPEAN SURVEY

Air-Cooled Diesel Engines

EXACTLY four years ago, the "European Survey" (see MECHANICAL ENGINEERING, September, 1954, p. 760) described and illustrated a new type of air-cooled diesel engine, delivering $3^1/_2$ hp at 1800 rpm, made by R. A. Lister & Company, Dursley, England, and designed for agricultural and similar duties. It proved to be very successful and was soon followed by a 7-hp model; then, by increasing the cylinder bore and going to two and three cylinders, the series was expanded to include $4^1/_4$-hp, $8^1/_2$-hp, and $12^3/_4$-hp sizes.

Now the makers have introduced two larger engines, the HA2 and HA3, rated at 20 hp and 30 hp, respectively, at 1800 rpm; these are continuous ratings, in accordance with the relevant British Standard Specification.

The HA2 has two cylinders and the HA3 has three, 4-in. bore and $4^1/_2$-in. stroke in each case. The combustion chamber is formed in the head of the aluminum-alloy piston and consists of four lobes, making a clover-leaf pattern in a bowl. This has been found to give very effective mixing of the fuel and air, and, with a compression ratio of 17:1, enables the engine to be hand-started from cold by two men in an ambient temperature of minus 4 F.

The crankshaft has 3-in. journals and runs in shell-type bearings. The big-end bearings are steel-backed, with copper-lead linings, with an oil groove in the upper half; the lower half is plain. Cooling is by a centrifugal fan bolted to the flywheel, the cooling air being trunked around the cylinders and over the finned fuel injectors, with baffles to direct a constant flow to all parts. Each cylinder has its own fuel pump, and the injector bodies are heat-insulated from the cylinders.

On test, the engines have run for 1000 hr continuously at full load in a hot chamber maintained at 140 F. The gear train is located at the opposite end to the flywheel and is covered by a steel pressing, held by clamps. The crankshaft pinion drives the camshaft gearwheel, and this in turn drives the governor, which runs at higher than engine speed and can hold the rpm within 4 per cent of the desired figure; closer governing is possible by changing the spring. An idler wheel below the crankshaft pinion drives the lubricating oil pump.

The bmep at 1800 rpm is 78 psi. On full load, running at 1200 rpm, the fuel consumption of the HA2 engine is 0.39 lb per hp per hr, and at 1800 rpm, 0.43 lb. The corresponding figures for the HA3 engine are 0.375 and 0.41 lb. One Imperial pint of lubricating oil will serve the HA2 for $14^1/_2$ hr, and the HA3 for 10 hr. The net weight of the HA2 is 670 lb and of the HA3, 760 lb, corresponding, respectively, to 33.5 lb and 25.3 lb per hp.

Economics of Nuclear-Powered Electricity Supply

WHEN, at the end of last year, Sir Christopher Hinton left the United Kingdom Atomic Energy Authority to become chairman of the Central Electricity Generating Board, the move was generally regarded as an indication of the increasing extent to which electric-power generation in the United Kingdom would depend on the erection of more and bigger nuclear power plants. This view was confirmed by the general trend of the address which he gave in June to the 10th British Electrical Power Convention, but in it he showed also that, in developing the use of nuclear power in this direction, there were economic considerations to be borne in mind which were not always appreciated.

The expanded British program, as announced in March, 1957, set a target of 5000 to 6000 mw of nuclear plant to be in service by 1965, and that program was based on the assumption that these stations would work as base load stations with an annual load factor of 75 per cent.

At present, Sir Christopher stated, the load factor of the British supply system is under 50 per cent, and the minimum continuous load is only about 3000 mw; this occurs at night during summer weekends and is, in effect, the base load on the system. This means that, after 1966, the total nuclear capacity will exceed the anticipated night load and, for part of their time, the nuclear stations would have to work at reduced load.

To be economic under such conditions, the nuclear stations must be capable of flexible operation; and, also, their capital cost per mw must be reduced. This involves the use of higher temperatures; but 450 C is about the maximum that can be accepted with cylindrical fuel elements in cans of magnesium alloy, the melting point of which is 640 C. Zirconium is a possible alternative,

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but not for gas-cooled reactors using CO_2 as a coolant (the system favored in Britain on safety grounds) because zirconium reacts with the gas at temperatures over 500 C. Beryllium, which melts at 1285 C, does not react with dry CO_2 at temperatures up to 600 C, but it is expensive and extremely toxic. Moreover, because of the temperature gradient in the fuel charge, to maintain 600 C at the can surface would involve a temperature of some 1200 C at the center of the uranium element, which would be much too high for metallic uranium.

The solution, Sir Christopher suggested, is to use enriched uranium in a ceramic form, i.e., in the form of an oxide, carbide, or silicide; but these are expensive. Unless, however, the desired flexibility can be achieved and the capital cost reduced, the growth of power demand may make it necessary to increase the rate of installation of conventional generating plant. The only alternative would be to continue to construct nuclear plants, even though the costs of generation would be higher per unit sent out.

Automatic-Transfer Progressive Coldheader

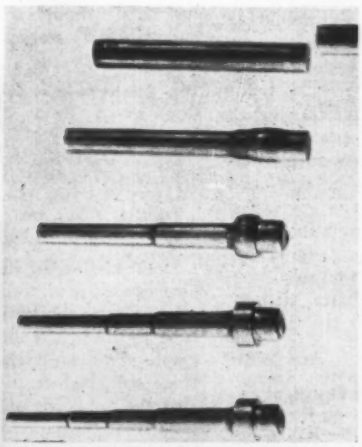
At the recent Swiss Industries Fair at Basel, the firm of F. B. Hatebur, whose works are in the same city, showed an automatic progressive coldheading press for the production of bolt blanks and similar components, mass-produced from coiled wire. The machine comes in three sizes, known, respectively, as the BKA-1, the BKA-3, and the BKA-4.

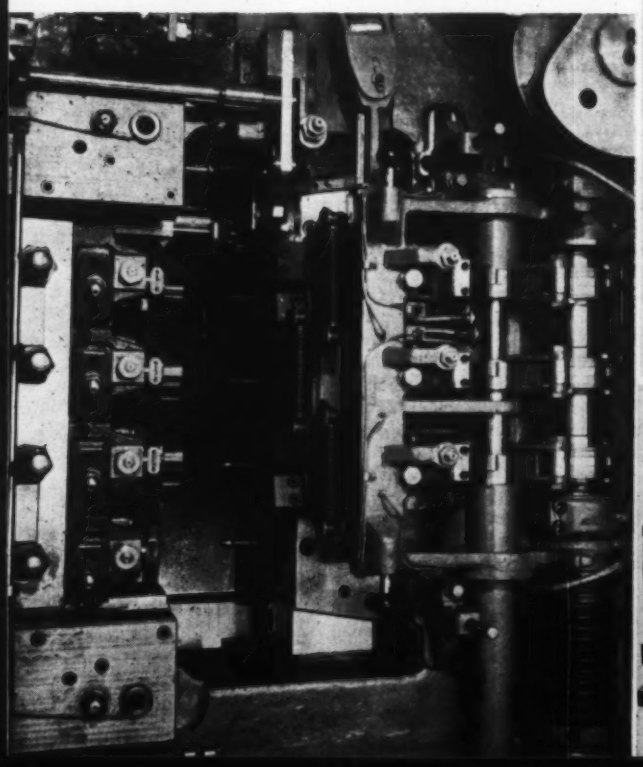
The BKA-3, the intermediate size, has five stations, the first shearing from the coil the desired length of wire which is then passed automatically through four heading stations in succession. The heading ram is supported on nitrided slides which guide it before and behind the crankshaft to insure precise alignment of the punches and dies.

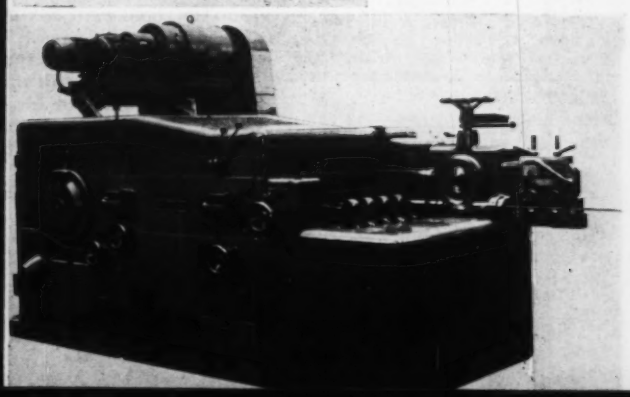
A centering adjustment is provided on each of the heading tools, in addition to the wedges behind the tools for the purpose of axial adjustment; and each punch holder is fitted with an ejector. The cut-off mechanism is designed to shear comparatively heavy sections (in the case of the BKA-3, up to $^3/_4$-in-diam wire of 38 tons tensile, or hexagon stock up to $^1/_8$ in. across the flats) so that the machine can be used on a variety of components; for example, bicycle pedal spindles.

For the same reason, the automatic transfer fingers are capable of a wide range of adjustment, independently at each heading station, and the opening and closing of each pair can also be separately timed. The complete transfer mechanism can be swung up to facilitate access to the heading tools. To prevent overloading of the parts and consequent jamming of the machine, safety devices are fitted to the shearing mechanism, the blank transfer gear, and the ejectors. They are linked to the electropneumatic clutch and brake control by microswitches, so that they stop the machine instantly.

The multiple-disk clutch and the brake can also be controlled from a push-button panel which provides for a single stroke, normal running, inching, and stopping. The machine always stops with the tools in the withdrawn position. The BKA-3 model is driven by a 35-hp motor and has an output capacity of 30,000 pieces per 8-hr shift. The maximum length of wire that can be cut off is 6 in., and the transfer fingers will handle pieces as small as 1 in. long.







Automatic progressive coldheader, BKA-3 model, built by F. B. Hatebur, Basel, Switzerland. *Far left*, tool layout shows cut-off shear at top and four heading stations below with transfer mechanism and operating cams. *Left*, sequence of operation when producing pedal spindle blanks. *Below*, general view of coldheader.

Substances in Brief of Papers Presented at ASME Meetings

M. ZANFARDINO
Staff Editor

ASME TECHNICAL DIGEST

Heat Transfer

Heat Transfer to a Boiling Liquid: Mechanism and Correlations....58—HT-11

By K. E. Forster and R. Greif, Assoc. Mem. ASME, University of California, Los Angeles, Calif. 1958 ASME-AIChE Joint Heat-Transfer Conference paper (multilithographed; available to June 1, 1959).

Various heat-transfer mechanisms which have been previously proposed are analyzed in the light of recent experiments. Evidence is presented in favor of a vapor-liquid exchange mechanism and against the widely accepted "microconvection" mechanism. The vapor-liquid exchange mechanism is shown to explain the insensitivity of boiling heat flux to the level of subcooling. A "Reynolds analogy" for nucleate boiling is presented in some detail. A procedure is given for calculating the superheat at which the liquid bulk velocity ceases to contribute to the heat flux. An expression for the growth of a vapor bubble in a highly superheated liquid is deduced. A method is presented which allows the deduction of correlations for nucleate boiling which give the correct dependence of heat flux on superheat and system pressure. Two such correlations are presented and results are compared with experiment. Data are presented which show that one correlation yields the heat flux for 5 different liquids including liquid metals, for pressures ranging from 1 to 50 atmospheres, without necessitating a change in the constant of the correlation.

The Use of Steady-State Electrical Network Analysis in Solving Heat-Flow Problems.....58—HT-14

By A. D. Kraus, Assoc. Mem. ASME, Sperry Gyroscope Company, Great Neck, L. I., N. Y. 1958 ASME-AIChE Joint Heat-Transfer Conference paper (multilithographed; available to June 1, 1959).

In a device as complicated as a transistor, one finds that no simple electric equivalent circuit can be used to represent the configuration adequately. In addition, any simplification made will usually tend to reduce the accuracy of the computation. More elegant methods of circuit analysis are therefore dictated since the usual step-by-step combination of thermal resistances may no longer be possible.

The electrothermal analogy in which a heat-flow pattern is represented by an equivalent electrical circuit has been in use for a great many years. Frequently, however, in order to obtain a circuit in a form available for rapid solution, many simplifying assumptions are made. This paper describes four of the more powerful methods of steady-state electrical network (circuit) analysis that can be applied to the solution of heat-flow patterns in which simplifying assumptions need not be made. The methods described in this paper are those of mesh or loop analysis, nodal analysis, and the theorems of Thévenin and Norton. These methods are more elegant and powerful but are still simple enough to allow rapid computations with more accuracy.

The Effectiveness of a Transistor Cap as a Heat Dissipator....58—HT-15

By A. D. Kraus, Assoc. Mem. ASME, Sperry Gyroscope Company, Great Neck, L. I., N. Y. 1958 ASME-AIChE Joint Heat-Transfer Conference paper (multilithographed; available to June 1, 1959).

In the cooling of small semiconductor devices used in airborne electronic equipment, precise application of the heat-dissipating surface is required in order to assure minimum coolant flow. Some of these semiconductors are constructed so that the cap is the only heat-conducting path from the junction of the device to the cooling stream. Although the heat dissipation is minute, in some cases, less than half a watt, the surface for heat transfer is so small that severe temperature problems are encountered.

This paper presents a derivation for the fin effectiveness of a transistor cap and illustrates the use of this parameter in predicting case temperature.

Experimental Forced Convection Heat Transfer With Adiabatic Walls and Internal Heat Generation in a Liquid Metal.....58—HT-17

By G. L. Muller, Assoc. Mem. ASME, Pratt & Whitney Division, United Aircraft Corporation, Middletown, Conn. 1958 ASME-AIChE Joint Heat-Transfer Conference paper (multilithographed; available to June 1, 1959).

The phenomena associated with a liquid metal flowing turbulently through an insulated pipe when heat is generated uniformly in the fluid were investigated experimentally. The results are compared with the analysis of H. F. Poppendiek for this case using the heat-momentum transfer analogy of Martinelli. A direct test of the analogy is afforded, since there is no heat transferred to the wall, and interfacial resistances cannot affect the results. The results have application to liquid-metal-fueled nuclear reactors, where heat is generated in the fuel as it flows through the core. Poppendiek's analysis is reworked into an integral form similar to that given by Lyon for the heat-transfer coefficient so that the effect of internal heat generation on the coefficient can be more clearly seen.

Vortex-Flow Temperature Separation of Spiral and Axial Flows.....58—SA-71

By J. E. Lay, Assoc. Mem. ASME, Michigan State University, East Lansing, Mich. 1958 ASME Semi-Annual Meeting paper (multilithographed; available to April 1, 1959).

An experimental and analytical study of compressible flow in a uniflow vortex tube is discussed. Part 1 deals with an experimental study, Part 2 with the analytical study. Its purpose is to provide a better understanding of the separation of a gas stream into regions of high and low stagnation temperatures, there being at present little agreement as to the theory of operation.

The problem is first approached from the experimental standpoint. A large, multipurpose vortex tube is so designed

and built that pressure, temperature, and velocity traverses can be taken at six different stations throughout the length of the tube. Pressure, temperature, and velocity traverses are taken by means of hypodermic probes. Velocities are checked by means of a miniature hot-wire anemometer. Data are taken for different runs of inlet pressures and plotted against radial distance. Flow visualization is obtained by means of liquid injection.

The analytical study consists of using superposition for the solution of the flow equations. It begins with potential vortex flow in the plane. The solution of this flow is characterized by the existence of sonic or limit circles. Superposition of a sink flow to the vortex solution yields a spiral flow in the plane. The general solution in space is obtained by addition of a uniform axial velocity to the spiral flow. When viscosity effects are considered, the potential vortex changes into a forced vortex and the solution becomes a superposition of a viscous compressible sink to a forced vortex. Performance or stagnation temperature separation is expressed as a function of the ratio of vortex strength to sink strength.

Calculation of Transients in a Crossflow Heat Exchanger....58—HT-5

By G. M. Dusinberre, Fellow ASME, The Pennsylvania State University, University Park, Pa. 1958 ASME-AIChE Joint Heat-Transfer Conference paper (in type; to be published in *Trans. ASME;* available to June 1, 1959).

Recent months have shown indications of a great deal of interest in the prediction of transient phenomena in heat exchangers and other heat-transfer systems. Most of the methods proposed involve the use of analog equipment not usually found in engineering offices, or else the use of extremely complicated formulas reached by analysis. It seems in order, then, to point out the application of numerical methods to these problems, since the necessary equipment for small-scale problems (a desk calculator or even a slide rule) is available in every engineering office, and the necessary equipment for a large-scale problem (a digital computer) is coming to be available almost everywhere.

This paper shows how transient temperatures in a crossflow heat exchanger may be calculated by numerical methods. Digital computer programming is considered. A gas-turbine regenerator is used as an example. In particular, methods are developed which are useful when the flow rates vary, as in the starting transient.

Wave Theory of Heat Transfer in Film Boiling.....58—SA-19

By Yan Po Chang, University of California, Los Angeles, Calif. 1958 ASME Semi-Annual Meeting paper (in type; to be published in *Trans. ASME;* available to April 1, 1959).

This paper is an extension of a previous one (see *Trans. ASME*, vol. 79, 1957, pp. 1501–1513) in which heat transfer has been analyzed by the wave theory for natural convection and for nucleate boiling in detail, and for film boiling in principle. In the present paper, heat transfer in saturated and subcooled film boiling from horizontal and vertical surfaces is analyzed from the viewpoint of the previously presented idea. By means of the concept of equivalent thermal diffusivity a generalized Prandtl number is recommended. Thus a general formula is obtained for both convection and boiling. The predicted results agree very well with the experiments of previous investigators.

Dynamic Response of Heat Exchangers Having Internal Heat Sources—Part III.....58—SA-39

By V. S. Arpaci, Massachusetts Institute of Technology, Cambridge, Mass.; and J. A. Clark, Assoc. Mem. ASME, University of Michigan, Ann Arbor, Mich. 1958 ASME Semi-Annual Meeting paper (in type; to be published in *Trans. ASME;* available to April 1, 1959).

This paper is an extension of two of the authors' previous papers (see *Trans. ASME*, vol. 80, 1958, pp. 612–634) and considers the dynamic response of the temperature of the heat-transfer surface and the fluid-surface temperature difference in a heat exchanger having internal heat sources.

A general solution is presented for a transient resulting from an arbitrary time rate of change of heat generation starting from an arbitrary initial condition. The results are obtained by a direct mathematical attack on the governing differential equations.

As a special case, the transient resulting from a linear time rate of change of internal heat generation is given, and this is compared with both experimental and theoretical results corresponding to a step change in heat generation. Satisfactory comparison is obtained. The results for this special case are presented such that the surface temperature and fluid-surface temperature difference may be computed as a function of space and time using four dimensionless, mathematical functions which are given in graphical form.

It is shown how the case of the linear time rate of change of internal heat generation may be used to compute the dynamic response of this type of heat exchanger for any transient resulting from excursions in heat-generation rate which may be approximated piecewise by a series of linear functions of time. Heat exchangers to which these solutions apply include the heterogeneous nuclear reactor.

Transient Temperature Distribution and Thermal Stresses in a Hypersonic Unsymmetrical Wing Structure at Angles of Attack....58—SA-63

By Shih-Yuan Chen, Assoc. Mem. ASME, Republic Aviation Corporation, Farmingdale, L. I., N. Y. 1958 ASME Semi-Annual Meeting paper (multilithographed; available to April 1, 1959).

The analytical solution of transient temperature distributions and thermal stresses in a hypersonic wing structure subjected to aerodynamic heating at angles of attack is presented in this paper. The heat-transfer coefficients and adiabatic wall temperatures are different for both upper and lower wing surfaces.

The effects of aerodynamic heating and conduction through the structural members are considered with conduction, convection, and radiation through the air trapped within the structure and radiation to space neglected.

The structure considered is unsymmetrical with respect to the horizontal axis but symmetrical with respect to vertical axis. Different materials, parameters, and dimensions are taken for the upper flange, web, and lower flange in order to obtain a general solution.

A Boundary-Layer Treatment of Laminar-Film Condensation.....58—SA-2

By E. M. Sparrow, Assoc. Mem. ASME, and J. L. Gregg, National Advisory Committee for Aeronautics, Cleveland, Ohio. 1958 ASME Semi-Annual Meeting paper (in type; to be published in *Trans. ASME;* available to April 1, 1959).

Laminar-film condensation on a vertical plate is studied using the mathematical techniques of boundary-layer theory. Starting with the boundary-layer (partial differential) equations, a similarity transformation is found which reduces them to ordinary differential equations. Energy-convection and fluid-acceleration terms are fully accounted for. Solutions are obtained for values of the parameter $c_p\Delta T/b_{fg}$ between 0 and 2 for Prandtl numbers between 1 and 100. These solutions take their place in the boundary-layer family along with those of Blasius, Pohlhausen, Schmidt and Beckmann, and so on. Heat-transfer results are presented. It is found that the Prandtl-number effect, which arises from retention of the acceleration terms, is small for Prandtl numbers more than 1.0.

Applied Mechanics

Response of Complex Structures From Reed-Gage Data.....58—APM-15

By Sheldon Rubin, Mem. ASME, Hughes Aircraft Company, Culver City, Calif. 1958 ASME West Coast Conference of the Applied Mechanics Division paper (in type; to be published in the *Journal of Applied Mechanics;* available to July 1, 1959).

A primary reason for measuring transient motions or forces is that, from such measurements, calculations of structural response can be made. In terms of the form of the recorded information there are two types of instrumentation systems which are useful for response analysis. The first of these types attempts to record the true time history of the excitation. This measured excitation is then applied to the structure as a forcing function either by a computational process or by electrical analog simulation. An instrumentation system of the second type records structural-response information directly. The first type is more frequently used, but recently there has been interest in the more direct measurement of structural response afforded by the second type.

An instrument of the second type should be, in essence, a dynamic model of the structure whose response is to be determined. This is most generally accomplished by a relatively new instrument known as the reed gage.

The paper considers the general applicability of the reed gage, an instrument which records the peak response to a transient motion of single-degree-of-freedom systems. These recorded data permit the calculation of peak response in each vibrational mode of a complex structure experiencing the measured excitation as a base motion. An upper bound to the maximum structural response can be obtained by summing the peak responses in each of the modes. An analysis is made of the error inherent in this superposition process. In many practical problems the distribution of mode frequencies and the form of the excitation is such that this error is not of great significance.

Some Shock Spectra Characteristics and Uses.....58—APM-5

By Y. C. Fung, California Institute of Technology; and M. V. Barton, Mem. ASME, The Ramo-Wooldridge Corporation, Los Angeles, Calif. 1958 ASME West Coast Conference of the Applied Mechanics Division paper (in type; published in the *Journal of Applied Mechanics*, September, 1958; available to July 1, 1959).

A shock spectrum is a plot showing the peak response of a linear variable-frequency oscillator (of single degree of freedom) to a specific shock wave, as a function of the frequency of the oscillator. Such a spectrum may be measured, for example, by multifrequency reed gages and is sometimes used as a basis either for specifying the shock wave or for computing the response of a multi-degree-of-freedom structure to such a shock.

In this paper these applications of the shock spectrum are discussed. In particular, it is shown that, if the fundamental frequency (f_1, cps) of the structure is sufficiently high, a close approximation of the peak response of a multi-degree-of-freedom system can be obtained by the algebraic sum (not the sum of absolute values) of the peak responses of the individual degrees of freedom. Numerical results for a uniform cantilever beam subjected to a shock load uniformly distributed over its span show that the high-frequency requirement is satisfied if $2f_1t_m \geq 1$, where t_m(sec) is the rise time of the pulse.

The Flexure of a Uniformly Pressurized, Circular, Cylindrical Shell .....58—APM-13

By J. D. Wood, The Ramo-Wooldridge Corporation, Los Angeles, Calif. 1958 ASME West Coast Conference of the Applied Mechanics Division paper (in type; to be published in the *Journal of Applied Mechanics;* available to July 1, 1959).

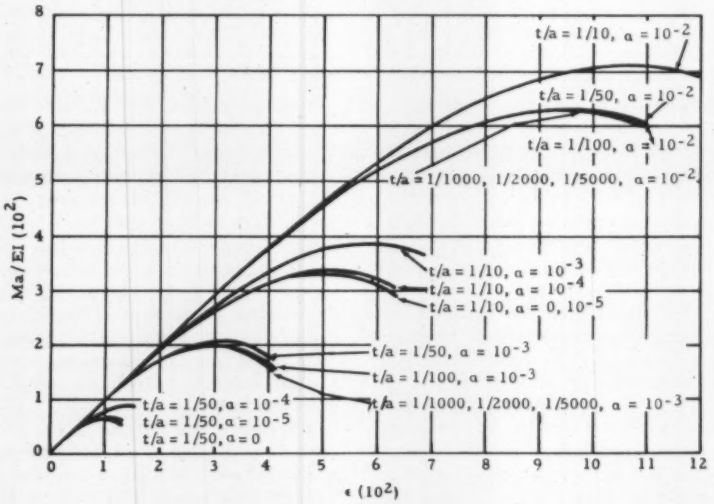
The moment-curvature relationship and the components of displacement in the cross section of a uniformly pressurized, long, closed, circular, cylindrical shell are presented in this paper. The shell is loaded in one of its principal planes by two equal and opposite terminal couples: First, the shell undergoes small initial displacements. These are formed by superimposing pressurization displacements upon Saint Venant diplacements. Second, from this deformed position the shell is perturbed into a system of additional small displacements. A Rayleigh-Ritz technique is used to find the latter displacements from the theorem of minimum potential energy. The point at which the moment-curvature relationship becomes nonlinear is shown by several curves in this paper.

The Plastic Deformation Due to Impact of a Cantilever Beam With an Attached Tip Mass....58—APM-4

By T. J. Mentel, University of Minnesota, Minneapolis, Minn. 1958 ASME West Coast Conference of the Applied Mechanics Division paper (in type; to be published in the *Journal of Applied Mechanics;* available to July 1, 1959).

A theoretical analysis, based on the assumption of ideal plastic-rigid behavior is made of the deformation of a uniform cantilever beam with an attached tip mass, which results from a transverse acceleration of the base of the cantilever. The problem is also investigated experimentally and an assessment is made of the theoretical work. A simplified analysis based on a one-dimensional model is found to give results which are very close to those obtained by analysis of the continuum model, but in both cases it is found that corrections must be applied to obtain good results, because of effects neglected in both analyses. In the case of the experimental models tested, the principal correction appears to be that for strain-rate effects.

Moment-curvature relationship for a uniformly pressurized circular, cylindrical shell $\nu = 1/3$, $\alpha = P_o/E_t$, $\epsilon = a/\rho$ (58-APM-13)



Large Deflection of Stiffened Plates . . . . . 58—APM-18

By W. G. Soper, Los Alamos Scientific Laboratory, Los Alamos, N. Mex. 1958 ASME West Coast Conference of the Applied Mechanics Division paper (in type; to be published in the *Journal of Applied Mechanics;* available to July 1, 1959).

The problem of nonlinear deflection of orthogonally stiffened plates subjected to static lateral load is treated using the concept of equivalent orthotropic plates. Equations are derived which are the appropriate generalizations of von Karman's equations for isotropic plates. Rectangular plates are considered in detail, and an approximate solution is obtained through trigonometric series. The solution allows for rotational constraint along the plate boundary. All cases from simple support to complete fixity of boundary can therefore be treated.

Large Symmetric Deflections of Annular Plates . . . . . 58—APM-12

By G. A. Wempner, Mem. ASME, and R. Schmidt, University of Illinois, Urbana, Ill. 1958 ASME West Coast Conference of the Applied Mechanics Division paper (in type; to be published in the *Journal of Applied Mechanics;* available to July 1, 1959).

This paper presents a series solution of the von Karman equations for axially symmetric deflections of annular plates. A numerical procedure is described for evaluating the coefficients in the series. Results obtained by this procedure are given for a plate subjected to axial edge loads. A method is presented for demonstrating convergence and appraising the errors.

Some Solutions of the Timoshenko Beam Equation for Short Pulse-Type Loading . . . . . 58—APM-3

By H. J. Plass, Jr., Mem. ASME, The University of Texas, Austin, Texas. 1958 ASME West Coast Conference of the Applied Mechanics Division paper (in type; published in the *Journal of Applied Mechanics,* September, 1958; available to July 1, 1959).

A collection of solutions to the Timoshenko beam equation is presented. Various types of support conditions and impact conditions are included. In every case the impact is assumed to be a pulse in the form of a half-sine wave. The results were found numerically, using the method of characteristics, except for one case, which was done in addition by the Laplace transform method, for check purposes. Agreement with experiment is good except for a pulse of duration comparable to the time required for the bending-type wave to travel a distance of one diameter. Discussion is included of the differences among the various cases studied.

Stresses Produced in a Half Plane by Moving Loads . . . . . 58—APM-8

By J. Cole, California Institute of Technology, Pasadena, Calif.; and J. Huth, Mem. ASME, The Rand Corporation, Santa Monica, Calif. 1958 ASME West Coast Conference of the Applied Mechanics Division paper (in type; to be published in the *Journal of Applied Mechanics;* available to July 1, 1959).

A study is made of stresses and displacements induced in an elastic half plane (plane strain) by a concentrated line load moving at a constant speed along its surface. The stress field for an arbitrary load distribution can be built up by superposition of these concentrated-load solutions. Three cases are considered: (*a*) The load is moving more slowly than either the longitudinal or transversal wave speeds of the elastic medium (subsonic case). (*b*) The load speed is between the two wave speeds (transonic case). (*c*) The load speed is greater than either wave speed (supersonic case). In each of these cases the nature of the singularity caused by the load is examined and the complete solution is given.

The Vibration of a String Having a Uniform Motion Along Its Length . . . . . 58—APM-7

By F. R. Archibald, Mem. ASME, and A. G. Emslie, Arthur D. Little, Inc., Cambridge, Mass. 1958 ASME West Coast Conference of the Applied Mechanics Division (in type; published in the *Journal of Applied Mechanics,* September, 1958; available to July 1, 1959).

In calculating the natural frequencies of a power chain or belt it is usual to use the theory of vibrating strings. However, the speed of the chain or belt may be a considerable fraction of the wave velocity as given by $(T/\rho)^{1/2}$. It might be expected that this would have a marked effect on the natural frequencies. This is shown to be so and the formula for the natural frequencies of a moving string is obtained. The problem of the forced vibration of the string is also considered.

Physical Properties of Plastics for Photothermoelastic Investigations. . . . . 58—APM-2

By H. Tramposch and G. Gerard, Mem. ASME, New York University, New York, N. Y. 1958 ASME West Coast Conference of the Applied Mechanics Division (in type; to be published in the *Journal of Applied Mechanics;* available to July 1, 1959).

The optical and physical properties of Paraplex P43, Castolite, and epoxy resin Hysol 6000-OP, which are potentially of interest in photothermoelastic investigations, were investigated over a temperature range from +100 to −60 F. Results on the thermal-expansion coefficient, the material fringe value, and the modulus of elasticity as functions of temperature are presented. Also evaluated were thermal properties of importance in heat conduction. Photothermoelastic figures of merit, which rate the optical sensitivity of materials in photothermoelastic applications, as well as a new method to determine this figure in a relative manner are presented.

Design of Accelerometers for Transient Measurements . . . 58—APM-6

By Sheldon Rubin, Mem. ASME, Hughes Aircraft Company, Culver City, Calif. 1958 ASME West Coast Conference of the Applied Mechanics Division paper (in type; to be published in the *Journal of Applied Mechanics;* available to July 1, 1959).

The purpose of this study is to find a significant accelerometer accuracy criterion for measuring transients, and to apply it to the investigation of optimum damping and the range of frequency response required. It is proposed that the effect of instrument distortions on the response spectrum of a transient be used to evaluate the acceptability of the measurement. The application of this response-spectrum criterion to some selected acceleration pulses indicates that the optimum instrument damping for a transient measurement is essentially the same as for the measurement of periodic motions and that the accelerometer period should be less than 0.4 of the pulse duration for 5 per cent accuracy. A reasonable generalization of the results to more complex transients is made.

Transient and Residual Stresses in Heat Treated Plates . . 58—APM-14

By H. G. Landau and J. H. Weiner, Mem. ASME, Columbia University, New York, N. Y. 1958 ASME West Coast Conference of the Applied Mechanics Division paper (in type; to be published in the *Journal of Applied Mechanics;* available to July 1, 1959).

Equations are given for determining transient and residual thermal stresses in a heat-treated plate. The material of the plate is assumed to be elastic, perfectly plastic. The temperature is assumed uniform on any plane parallel to the faces of the plate but can vary arbitrarily in the direction normal to the face and in time. The stress distribution during the unloading period is determined exactly without the simplifying assumption of simultaneous unloading. Application is made to the determination of stresses during cooling of a uniformly heated plate.

The stress-distribution sequence and residual stresses are calculated for several values of cooling rate and yield stress.

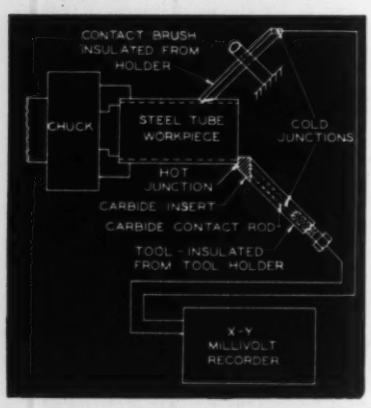
Production Engineering

A Study of the Effects of Tool Flank Wear on Tool Chip Interface Temperature.....58—SA-41

By D. R. Olberts, Assoc. Mem. ASME, Allis-Chalmers Manufacturing Company, Milwaukee, Wis. 1958 ASME Semi-Annual Meeting paper (in type; to be published in *Trans. ASME;* available to April 1, 1959).

A study of the effect of land wear upon the interface temperature between a carbide tool and an AISI 1015 steel workpiece is presented. The wear lands were ground on the tools to eliminate the effects of cratering and to produce uniform wear lands. The tool-work thermocouple technique was used to measure the interface temperature. A calibration of the thermocouple was obtained through the use of a technique suggested by Backer and Krabacher. The results at all feeds and speeds indicate that a wear land of 0.010 in. produces a lower interface temperature than a sharp tool. When the wear land increases beyond 0.010 in. to 0.020 and 0.030 in., the temperature again rises. Studies of the variation of the chip thickness ratio with wear land indicated that the greater the land wear the lower the chip thickness ratio.

Experimental setup used to determine cutting temperatures (58—SA-41)



Grinding a Titanium Alloy With Coated Abrasives.....58—SA-44

By D. E. Cadwell, H. L. Weisbecker, and W. J. McDonald, Minnesota Mining and Manufacturing Company, St. Paul, Minn. 1958 ASME Semi-Annual Meeting paper (multilithographed; available to April 1, 1959).

Titanium alloys are presently attracting considerable interest and showing great future promise because of their high strength-to-weight ratios and corrosion resistance.

However, owing to the unusual combination of properties, represented by a titanium alloy, conditions frequently used in grinding other structural metals with coated abrasives are uneconomical, or unsafe with this metal.

This single factor is absolutely critical in grinding titanium alloys with coated abrasives. If galling is not controlled, abrasive performance will be unsatisfactory; if it is controlled, performance is at least fair, regardless of other factors.

This paper presents results of a study of coated abrasive belt performance in titanium grinding. The effects of the variables load, speed, mineral, grit size, lubricant, and in the case of water-based lubricants, lubricant concentration, are shown. Lubrication was found to be the most significant factor in abrasive performance. Aqueous solutions of $NaNO_2$, KNO_2, Na_3PO_4, and K_3PO_4 are evaluated and discussed in comparison with representatives of the following lubricant classes: Sulfur and chlorine-bearing cutting oils, oil-in-water emulsions, commercial rust-inhibitor formulations modified for titanium grinding, and air. Performance increases with load, decreases with speed. For stock-removal operations, grits 50–80, high loads, and strong aqueous phosphate-solution lubricants gave best results. Chemically active organic lubricants may be better than aqueous solutions where maximum stock removal is not the major consideration.

Minimizing Waste in Strip Cutting.. .....58—SA-72

By G. G. O'Brien, Touche, Niven, Bailey & Smart, Detroit, Mich. 1958 ASME Semi-Annual Meeting paper (multilithographed; available to April 1, 1959).

The discipline referred to as "linear programming" has contributed much to the solution of problems of both a military, and more recently, an industrial nature. Linear-programming problems include all of those problems which can be expressed completely as a set of m-linear inequalities (or equalities) in n-non-negative variables, with a linear function of the n-variables to be optimized; i.e., either made a maximum or a minimum. Any one of the three possibilities, $m = n$, $m > n$, $m < n$ is possible. If the problem in question can be represented in this way, and has a solution, it can be solved by a technique called the simplex method.

A Look at Russian Automation and Technical Developments..... .....58—SA-11

By N. L. Bean, Mem. ASME, Ford Motor Company, Livonia, Mich. 1958 ASME Semi-Annual Meeting paper (multilithographed; available to April 1, 1959).

As part of an American team of engineers, the author toured Russia in December, 1955. A brief survey is given in this paper of Russian automation and technical developments. The author is impressed by the eagerness of the Russian people to improve industrial conditions and industrial techniques which is matched only by their aggressiveness in attacking problems involved in bringing their industry abreast with manufacturing conditions in other countries. Their attitude indicated that they still look upon the United States as a leader in modern industry, and it appears that their aim is to equal or better any industrial processes we have now. With the progress they are now making, it is entirely possible that they can rather quickly narrow the gap between their capacity and ours. They already have men who know how to improve their productivity and they are training thousands more.

Automation Progress in the United States.....58—SA-52

By L. D. Miller, Assoc. Mem. ASME, *Automation* Magazine, Cleveland, Ohio. 1958 ASME Semi-Annual Meeting paper (multilithographed; available to April 1, 1959).

Progress in automation has been evolutionary. This progress has included evolution in the concept, in its acceptance, and in techniques and hardware for applying it. The concept is related to, but different than, mass production and mechanization, and its acceptance has been evidenced by management, organized labor, and the general public.

Some of the techniques important in the application of automation are the systems approach, standardization, use of building blocks, cross-breeding of ideas, and more pre-engineering. Developments in these areas have led to, and been dependent on, developments in plants, equipment, and components. A few of the many hardware developments are mentioned to illustrate some of the interesting steps marking automation progress in the United States.

Process Industries

Mathematical Relationships for Computer Control Systems..... .....58—SA-59

By T. M. Stout, The Thompson-Ramo-Wooldridge Products Company, Los Angeles, Calif. 1958 ASME Semi-Annual Meeting paper (multilithographed; available to April 1, 1959).

In the design of a computer control system for a refining, chemical, or similar process, it is necessary to consider three

kinds of mathematical relationships between process variables. These are (*a*) a "profit equation" which expresses the economic objectives of process operation; (*b*) a set of "constraints" or restrictions imposed on process operation by material availability, product quality specifications, equipment ratings, safety requirements, and so on; and (*c*) relationships developed from fundamental physical and chemical principles, including material and energy balances, reaction kinetics and equilibria, material properties, and so forth.

These relationships are used in the design stages for determining functions to be performed by the control system and predicting benefits to be expected from its installation. They also may be incorporated in the control system as a means for finding best operating conditions, checking instruments, or detecting the existence of hazardous conditions which cannot be identified by checks and single variables. Relationships of the third kind present the greatest difficulties and require the greatest effort. Methods are being found to solve these problems.

An Example of System Design by Logic.....58—SA-60

By E. S. Taylor, E. I. du Pont de Nemours & Company, Inc., Wilmington, Del. 1958 ASME Semi-Annual Meeting paper (multilithographed; available to April 1, 1959).

Instrument engineers have achieved a fair degree of success in applying process analyzers, such as the infrared, ultraviolet, refractive index, electrolytic, and chromatographic types. With success, however, come greater demands not only on the analyzer but on the over-all system. The complexity of control circuit requirements, for example, requires careful design to assure reliability, adequacy, minimum number of physical components, and so on.

This paper describes a tool which simplifies the work of the designer of special alarm circuitry for a process stream analyzer—Boolean algebra. This algebra was formulated by George Boole in 1847. A recent instrument application within the du Pont Company is described with emphasis on the manner in which the alarm circuitry was developed.

Boolean algebra, a branch of mathematical logic, furnishes a method whereby statements of system requirements are represented by equations or logic symbols. The latter can be operated on by prescribed methods to simplify, modify, and check the adequacy of the original statements. The final equations and diagram are readily reduced to their electrical equivalents.

Hydraulics

Friction Factors for Turbulent Flow in Curved Pipes.....58—SA-14

By H. Ito, Tōhoku University, Sendai, Japan. 1958 ASME Semi-Annual Meeting paper (in type; to be published in *Trans. ASME;* available to April 1, 1959).

Determination of the law of resistance for turbulent flow through straight pipes has been the subject of many exhaustive investigations. Comparatively few records are available, however, with regard to the influence of curvature, especially for turbulent flow.

Such curved pipes are largely used in heating and refrigeration in order to transfer heat from one fluid to another, and the clarification of the law of resistance offers an important indication in deciding the pressure required to obtain the necessary circulation and the rate of heat transfer for a given circulation.

The object of this paper is to furnish the engineer with reliable data on the friction factors to be used in computing the pressure losses for turbulent flow in smooth curved pipes. The empirical formulas proposed, backed by theoretical considerations, appear to define the influence of curvature upon the law of resistance with satisfactory accuracy.

Studies of Jet Compression—I, Apparatus and Methods. Results With Air at Room Temperature.....58—SA-13

By H. J. Hoge, S. S. Eichacker, and S. L. Fiske, Quartermaster Research and Engineering Center, Natick, Mass. 1958 ASME Semi-Annual Meeting paper (in type; to be published in *Trans. ASME;* available to April 1, 1959).

An experimental jet compressor (ejector) employing gases at subatmospheric pressures is described and data are presented showing efficiencies obtained with air used as both the driving and the driven fluid. A technique is described by means of which efficiency may be determined as a function of outlet pressure and entrainment ratio. Curves are presented showing that efficiency passes through a maximum as outlet pressure is increased. The compression ratio of the driven fluid likewise passes through a maximum as the outlet pressure is increased, but the maximum of efficiency occurs at a slightly higher pressure than the maximum of compression ratio. The highest efficiency achieved was 20.6 per cent at an entrainment ratio of 1.3 and a compression ratio of 1.14. The ratio of pressure of driven stream to pressure of driving stream at time of contact has been determined. The value of this pressure ratio corresponding to maximum efficiency was found to increase linearly with entrainment ratio, over most of the range of the measurements.

Prediction of Choking Flow in Centrifugal Impellers.....58—SA-15

By Harold Lown and F. J. Wiesner, Jr., Mem. ASME, Carrier Corporation, Syracuse, N. Y. 1958 ASME Semi-Annual Meeting paper (in type; to be published in *Trans. ASME;* available to April 1, 1959).

A method for predicting choking flow in centrifugal impellers is outlined in this paper. The theoretical development of the sonic flow equations for an ideal gas in an impeller passage is combined with empirical data through the derivation of a passage contraction ratio based upon test data. Construction of the three-dimensional passage throat area for two basic types of impellers is also outlined. Good correlation between experimental data and calculated choking flows for other centrifugal impellers is shown by the use of this method. Further utilization of this method for nonideal gases ranging in compressibility from 0.85 to 0.98 seems feasible if small errors can be tolerated.

Technical Considerations for the Application of Hydraulic Torque Converters.....58—SA-64

By H. J. Wirry, Twin Disc Clutch Company, Rockford, Ill. 1958 ASME Semi-Annual Meeting paper (multilithographed; available to April 1, 1959).

Discussion is presented of the following types of industrial converters available on the market today: (*a*) Single-stage converter-coupling; (*b*) single-stage, outflow stator; (*c*) single-stage, inflow stator; (*d*) single-stage, stationary housing; (*e*) three stage.

A brief résumé of converter theory is given first from which will evolve torque equations and a description of how a torque converter increases torque. Emphasis is placed upon the factors that determine stall-torque ratio and how it can be increased or decreased. This is followed by a description of the impeller-torque absorption curve for each of the foregoing converters, pointing out the significant factors that determine its shape and what performance conclusions are evident from the outset by a brief study of these curves. Next is shown a typical performance curve of each type of converter and a method discussed as to how one can be evaluated against the other. Other subjects discussed are of a mechanical nature, such as a clutch location—before or after the converter—design consideration for equipment following the converter, split torque, and cooling.

Machine Design

Structural Error Analysis in Plane Kinematic Synthesis...58—SA-12

By F. Freudenstein, Assoc. Mem. ASME, Columbia University, New York, N. Y. 1958 ASME Semi-Annual Meeting paper (in type; to be published in *Trans. ASME;* available to April 1, 1959).

Recently, a number of techniques for synthesizing mechanisms have been discussed in the literature. A basic requirement in applying these techniques is the attainment of motions which are sufficiently close approximations to the desired ones. As long as the number of adjustable mechanism proportions are finite, however, a difference will in general exist between the desired and generated motions and is called the structural error. This error exists in addition to those arising from manufacturing variations and elastic effects which are not considered here, but it can be minimized.

Methods are developed for estimating and obtaining minimum structural error in the approximate synthesis of plane, function, or path-generating mechanisms. The application to a four-bar function generating mechanism is worked out with the aid of a large-scale digital computer used in the manner of a servo loop.

How to Replace Gears by Mechanisms (Linkages).....58—SA-33

By Kurt Hain and Gerhard Marx, Braunschweig, Germany. 1958 ASME Semi-Annual Meeting paper (in type; to be published in *Trans. ASME;* available to April 1, 1959).

In most engineering branches oscillating transmissions with uniform ratio of transmission are demanded. Gears and cams can be used for this problem and are able to fulfill the exact uniform ratio. Mechanisms have a varying ratio of input angular velocity ω_a to output angular velocity ω_e, but they can be manufactured much cheaper and easier. Therefore, if small deviations from the constant transmission are admissible, mechanisms should be used.

In special cases exact transmissions are available, that is, when a parallel-crank linkage or a slider crank is considered. The latter should have a crank which is equal to the base. Other linkages, especially the four-bar linkage, have a varying ratio of transmission, and, in the sense mentioned, it has to be ordered that the ratio of transmission be as constant as possible. Thus the best linkage will be the one which has the smallest deviations from constant transmission.

The method shown in this paper treats four-bar linkages for oscillating motions and approximately constant transmission. The deviations from this constant amount are prescribed within certain tolerances. It is possible to graph diagrams by which the deviations and the quality of transmission can be obtained. The coefficients of these diagrams make possible the simple design of the corresponding linkage.

Analytical Design of an Ackermann Steering Linkage.....58—SA-31

By W. A. Wolfe, Mem. ASME, The University of British Columbia, Vancouver, B. C., Canada. 1958 ASME Semi-Annual Meeting paper (in type; to be published in *Trans. ASME;* available to April 1, 1959).

A method is outlined whereby the dimensions of an Ackermann steering linkage may be determined analytically. The theoretical relation between the angles of rotation of the front wheels of a vehicle is derived, and it is shown how this relation may be approximated by a symmetrical four-bar linkage.

The method is briefly as follows:

The basic relation between the angles of the four-bar linkage is derived and the theoretically correct relation between the angles is used to express the four-bar-linkage equation as a function of one variable. If this derived equation can be made equal to zero for a suitable range of wheel-turning angle by proper adjustment of the coefficients, then the magnitudes of the coefficients will determine the physical dimensions of the linkage.

A direction solution as indicated does not seem possible, so an approximate solution is developed by expressing the derived equation as a power series and adjusting the coefficients of this series so that the sum of the lower-order terms deviates the least from zero.

Dynamic Loading of Spur Gear Teeth.....58—SA-32

By A. Y. Attia, Cairo, Egypt. 1958 ASME Semi-Annual Meeting paper (in type; to be published in *Trans. ASME;* available to April 1, 1959).

Results of strain-gage investigations conducted on steel gears to measure the instantaneous load on the tooth under static and dynamic conditions are presented in this paper.

The measuring apparatus is a 5-in. center gear testing machine. It is of the power circulating type in which two pairs of gears having the same tooth ratio are joined by two shafts in which torque is applied to load one pair of gears against the other, the driving motor being required to supply only the rotation and the power losses.

The test gears are mounted on readily accessible splined shafts in one gearbox which is fixed rigidly to the base of the machine, and the power return gears (or slave gears), which are of greater face width, are mounted on similarly splined shafts in another gearbox which is free to rotate in trunnions about the axis of the input drive shaft. The four gear shafts are jointed by means of splined sleeves to two coupling shafts, one of which incorporated two Hooke's joints to accommodate the movement of the power return gearbox in its trunnion. On the latter gearbox is built a balanced loading lever by means of which, together with the 1000-lb spring balance and screw device, torque can be applied to the gear system while the gears are rotating.

The two test gear shafts were replaced by two longer shafts extending to the outside test gearbox in order to carry the test gears in easily accessible positions. Each test gear is fastened to the flange of its shaft by ten pins.

Effect of Shotpeening on Fatigue Strength.....58—SA-46

By R. P. Felgar, Mem. ASME, General Electric Company, Schenectady, N. Y. 1958 ASME Semi-Annual Meeting paper (multilithographed; available to April 1, 1959).

The study reported in this paper was prompted by the need to understand the conditions under which shotpeening is expected to give improved fatigue strength to manufactured parts. During the past 29 yr a large amount of experimental data has been published indicating the beneficial effects of shotpeening on the fatigue strength of both laboratory specimens and manufactured parts.

It is easier to isolate the effects produced by shotpeening laboratory specimens than it is to isolate the effects produced by shotpeening manufactured parts. Therefore, in this paper, the data from fatigue tests on shotpeened laboratory specimens are studied to isolate the important effects of the shotpeening. Data from fatigue tests on shotpeened manufactured parts are then studied to determine which factors must be considered that were not present in laboratory specimens. Finally, a design procedure is presented for evaluating the influence of shotpeening on fatigue strength.

Shotpeening introduces three effects: (*a*) cold-working, (*b*) residual stress, and (*c*) concentrations. The relation of these effects to fatigue strength is discussed on the basis of data available in the literature. It is shown that the influence of the induced residual stress on the fatigue strength can be predicted on the basis of a concept due to Rosenthal and Sines. Prediction of the strength of

manufactured parts and laboratory specimens, based on this concept, agree closely with observed values.

The Design of Linkages to Generate Functions of Two Variables.....58—SA-57

By C. W. Allen, Assoc. Mem. ASME, General Electric Company, Richland, Wash. 1958 ASME Semi-Annual Meeting paper (multilithographed; available to April 1, 1959).

The synthesis of linkages to generate functions of one variable has been the subject of numerous investigations in the past and undoubtedly will continue to be a subject of wide interest for some time. The extension of the problem of designing linkages to include functions of two variables presents the designer with a new and versatile tool.

Graphical methods are presented for designing linkages that have two inputs and one output. Two basic approaches are developed. The desired function is matched at a limited number of positions with the maximum number being seven. Designs also are developed which match the derivatives of the desired function at a single point. The designs were developed for ease of solution and broadness of application.

Petroleum

Aerodynamic Vibration of Tall Cylindrical Columns....58—PET-4

By R. C. Baird, Mem. ASME, Santa Monica, Calif. 1958 ASME Petroleum Mechanical Engineering Conference paper (multilithographed; available to July 1, 1959).

Dynamic interaction of wind with tall cylindrical columns is described theoretically, and field-test results pertaining to an aerodynamically sensitive column are presented. Such columns are supported by reinforced-concrete bases, sized to allow for static wind loads. A column tightly bolted to its heavy concrete base may be thought of as one tine of a gigantic tuning fork possessing its own preferred modes of vibration. These modes and their frequencies are complicated functions of parameters of mass, mass distribution, moduli of elasticity, and so forth. Accordingly, if the phenomenon of wind vortex formation brings into existence alternating forces of a frequency close to a natural frequency of the column for a sufficient period of time, large amplitude oscillations can develop which may be exceedingly dangerous.

The result of applying a conventional type of cable stiffening to reduce the vibrational tendencies of a 155-ft column is shown by means of experimental data. Other possible solutions are described which involve mechanical and aerodynamic dampers. Meteorological conditions giving rise to vibration-inducing winds are discussed with special reference to the differing requirements for vertically and horizontally oriented cylindrical structures. Test procedures for investigating large-scale low-frequency structural vibration problems are outlined.

ASME TRANSACTIONS

The August, 1958, issue of the *Transactions of the ASME* (available at $1 per copy to ASME members; $1.50 to nonmembers), contains the following technical papers:

Controlled Starting and Loading of Modern Central Power Stations, by F. W. Kuehn. (57—PWR-7)

Operating Experience With High-Temperature Steam-Turbine Rotors and Design Improvements in Rotor-Blade Fastening, by J. D. Conrad and N. L. Mochel. (57—PWR-10)

The Propagation of Cracks and the Energy of Elastic Deformation, by H. F. Bueckner. (57—A-189)

Sulfuric Acid Corrosion in Oil-Fired Boilers—Studies on Sulfur Trioxide Formation, by D. R. Anderson and F. P. Manlik. (57—A-199)

An Investigation of the Variation in Heat Absorption in a Pulverized-Coal-Fired Slag-Tap Steam Boiler at Blaine Island, Charleston, W. Va., by A. A. Orning, M. Weintraub, C. H. Schwartz, E. A. Mihok, C. R. McCann, and W. C. Harrold

Effect of Temperature Variation on Composition, Fouling Tendency, and Corrosiveness of Combustion Gas From a Pulverized-Fuel-Fired Steam Generator, by J. D. Piper and Hazen van Vliet. (57—A-281)

A Simple Method of Estimating the Reynolds Number Effects on Aircraft Gas-Turbine Engines Operating at High Altitudes, by R. W. Pinnes. (57—A-157)

Effects of Stage Characteristics and Matching on Axial-Flow-Compressor Performance, by Aubrey Stone. (57—A-139)

Prediction of Creep in Bending From Tension- and Compression-Creep Data When Creep Coefficients Are Unequal, by W. N. Findley, J. J. Poczatek, and P. N. Mathur. (57—A-213)

Application of the Analog Computer to Product Dynamic Performance in Typical Hydraulic Circuits, by Gerhard Reethof. (57—A-97)

An Index of Cavitation Erosion by Means of Radioisotopes, by S. L. Kerr and Kjell Rosenberg. (57—A-64)

Cavitation and Nuclei, by R. T. Knapp. (57—A-80)

Study of Corrosion and Cavitation-Erosion Damage, by J. Z. Lichtman, D. H. Kallas, C. K. Chatten, and E. P. Cochran, Jr. (57—A-156)

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Note: No digests are made of ASME papers published in full or condensed form in other sections of MECHANICAL ENGINEERING.

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COMMENTS ON PAPERS

The Riding Comfort of Railroad Passenger Cars

Comment by Frank Fahland[1]

THE author is to be complimented on this fine paper.[2] He clearly has pointed out the many important items necessary to consider in providing improved riding.

The modern outside swing-hanger, four-wheel truck as described has eliminated most all of the objectionable vibrations except a fore and aft vibration, which, while not too objectionable, is still noticeable at times. This fore and aft, or longitudinal, vibration is not constant, but builds up and then recedes. The cause of this vibration has never been pinpointed on Union Pacific equipment with the truck described by the author.

The mention of three-quarter billion dollars worth of passenger transportation with little spent in research on this most important commodity is disturbing. However, with the railroads claiming a loss on passenger business, one can understand why more is not spent on passenger-car-truck research, especially since there are many other more important and pressing problems calling for the railroads' research dollar.

Under the possibilities of future investigations, the author states that the very nature of the physical laws involved requires that the location of the trucks be established to suit the mass and radius of gyration of the cars. While it may be theoretically advantageous to relocate the passenger car trucks, we are governed by location of equipment in the car and other physical conditions which fix the location of the trucks onto the car.

Another item mentioned for future investigation would be the determination of radius of gyration about the three axes of the car by experimental means. Here again the design engineers are governed by limitations which do not permit them to greatly change the radius of gyration of a car in any axis.

The suggestion to restrict the effect of wheel hunting is not understood, for we have found that a free-lateral roller bearing allowing wheel hunting provides an improved ride.

The author's suggestion to determine the minimum track conditions for riding comfort is excellent, however, the many factors involved such as alignment of track, track joints, approaches to curves, curves, track superelevation, weight of rail, and ballast makes this a complicated problem and one in which it will be difficult to get concurrence of the railroads' engineering departments.

The outside swing-hanger, four-wheel trucks, having the large central bearings, off-tread brakes, and free lateral journal bearings as developed by The General Steel Castings Corporation gives a good ride when properly maintained.

Comment by A. G. Dean[3]

I consider this paper[2] useful in stating concisely the principal problems involved in providing good riding quality for passenger equipment. It describes many useful solutions to individual problems and the need for continuing research.

The smooth road bed of a railroad would appear to make the problem of a good ride simple. Compared to other vehicles, however, this roadway is extremely narrow, requiring the strictest sort of guiding. Limiting the movement of the wheels introduces many problems peculiar to railroad operation. Rigid metallic wheels introduce high-frequency disturbances, as well as low frequencies. The vehicle itself presents a vibrating system of many degrees of freedom. This combination in effect defies precise analysis.

Because of the impossibility of setting up the entire problem in equation form, it has been approached piecemeal. A great deal of testing has resulted in considerable improvement in riding qualities although the various solutions have not been entirely consistent. By this procedure the basic design of an equalized truck with swing bolster, in remarkably few forms, has evolved over a period of many years into the most generally acceptable running gear.

Truck shimmy is the principal disturbance which interferes with passenger comfort. This has been principally the effect of worn wheel contours. Turning wheels eliminate the disturbance but some trucks have required this machining operation at prohibitively low-wheel mileage. The introduction of controlled friction at the center pivot has been a major break-through to all but eliminate this disturbance. Applications shortly after the war were immediately successful to the extent that one railroad reported it was no longer necessary to turn wheels for ride. The trucks on the Pennsylvania Railroad "Keystone" train are an excellent example of this principle. Wheel mileage exceeding 240,000 between turning has been reached without truck shimmy. This truck is about as described by the author, differing from normal design only in reduced axle centers (7 ft-2 in.) and reduced in capacity to 5×9 journals consistent with car weight. They weigh 14,400 lb each.

Spring rattle is indeed an annoyance. We find that inner coils of spring nests are sufficiently unstable to reduce any reasonable clearance between coils to the point where rattle is likely to occur. Our solution has been to coat these inner coils with a tough, sound deadening material to prevent metallic contact. This has practically eliminated rattle. Spring hum still exists and we know of no reasonable solution yet.

I think it fitting to include in this discussion some mention of our Pioneer III truck which, of course, has been con-

[1] General mechanical engineer, Union Pacific Railroad Company, Omaha, Neb. Mem. ASME.

[2] W. E. Burdick, "The Riding Comfort of Railroad Passenger Cars," MECHANICAL ENGINEERING, vol. 80, February, 1958, pp. 81–84.

[3] Chief engineer, Railway Division, The Budd Company, Philadelphia, Pa. Mem. ASME.

cerned vitally with all these problems. While this truck has not been the subject of an ASME paper, it has been described in a variety of publications and has aroused widespread interest. In this approach the vibration problem has been simplified by the use of a single-spring system which reduces the degrees of freedom of the vibrating system. Friction is provided in the pivot arrangement and rubber at the journal boxes as well as the load-carrying side bearings, helps minimize noise and wear. The air spring permits a stable single-spring system of low-natural frequency and practically eliminates the transmission of high-frequency vibrations and noise. The simplicity of the design, together with the reduction in number of wear areas, means that the adjustment or geometry should not vary due to wear for a long period of time. The disk brake minimizes wheel wear and noise and does not affect the spring action.

Inside journals inherently reduce weight by reducing size of parts and permitting a more efficient design of frame. They also permit an outside disk brake for easier inspection and maintenance. Wide and high location of air springs permits excellent roll stability. Equalization of the loads at the journals is accomplished by, in effect, pivoting the frame about a transverse axis.

This truck has been in test operation for over 100,000 miles now with no significant problems. The tread wear of the wheels at 100,000 miles was $^1/_{64}$ in. as close as we could measure with no measurable flange wear.

This truck design then provides for the characteristics listed as desirable in this paper with some important departures in methods of accomplishment permitting drastic weight reductions (to 63 00 lb at about 5 × 9 capacity), together with economies in cost and maintenance. We believe it has a promising future.

Comment by H. K. Lanning[4]

The author is to be congratulated on a concise and accurate coverage of the problems which affect the riding comfort of railroad-passenger cars, and has pointed the way to practical solution of some of these problems.

It might be pointed out that a well-designed car with suitable trucks can produce an unsatisfactory ride, if not properly maintained. With particular reference to the Commonwealth outside swing-hanger truck, described in the paper, it has been found that the rubber-cushion draft anchors used on this truck are critical as to adjustment. If tightened too tightly, there is a tendency for longitudinal oscillation to be transmitted into the car from the trucks. Fabric and rubber noise-deadening appliances are subject to deterioration and lose their effectiveness in eliminating noise and vibration when they lose their resiliency, or deteriorate to a point where they are lost from the assembly. The Commonwealth outside swing-hanger truck described in this paper is one that lends itself well to maintenance because of the accessibility of most of the parts for servicing.

The suggested research program on the part of the truck manufacturers, the car builders, and the railroads is desirable, not only from the standpoint of obtaining a better-riding passenger car on a well-maintained railroad, but also in an attempt to design passenger equipment which will give a satisfactory ride over all types of tracks, thereby giving the railroads some relief from the high cost of track maintenance.

The relationship between yaw, rail-joint spacing, and spacing between trucks should be further investigated. With 39-ft rails and 59-ft 6-in. spacing between truck centers, it seems that conditions to induce yaw are present, the rail joint being the weak part of the truck structure and with rail joints staggered, the trucks at opposite ends of the car go into a rail joint on opposite sides of the track almost simultaneously.

The author states that he has found little difference in riding comfort between four and six-wheel trucks of the Commonwealth design. This is no doubt true for well-maintained trucks of the type described; however, in general, I believe it can be said that a six-wheel truck in the average state of disrepair will generally give a better ride than a four-wheel truck in the same condition. A friction-type central bearing to reduce shimmy or its equivalent in a friction-type contact side bearing is a necessity when using four-wheel trucks, but can be omitted without serious consequences on cars having six-wheel trucks.

We would be interested in further research to determine whether the coil spring in conjunction with a shock absorber, which we have found to be an expensive maintenance item, can provide any better ride than elliptic spring having an equal spring constant and capable of some snubbing action because of its inherent ability to absorb energy.

We have used the three-way ride recorders on our road considerably to evaluate the riding qualities of both cars and tracks. Although their frequency response is limited to very-low-frequency vibrations, we believe it is the disturbances in this range which cause physical discomfort to the passenger and feel the three-way recorders give a good correlation with passenger reaction. We also use electronic accelerometers and displacement measuring devices recording on an oscillograph for a more detailed analysis of truck operation.

Comment by O. J. Horger[5] and W. P. Cox[6]

There is little engineering information published on this subject which makes this paper[2] a welcome contribution. Lateral motions of a car usually defy engineering analysis whereas vertical motions are better understood and controlled.

In our own road tests we prefer the use of a base car operated along with the car under test which the author did not mention as using. No changes are made in the base car throughout the tests. The ride of the car under test is always compared with that of the base car running with it in the same train. For example,

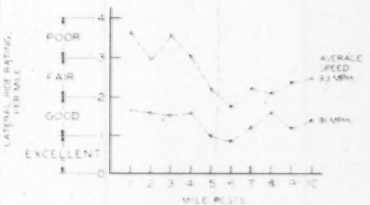

Fig. 1 Variation in ride of same car on two consecutive runs over the same track

Fig. 1 shows the lateral riding characteristics for two consecutive runs over the same tangent track of a parlor car used as a base car. While no mechanical changes were made in this car between the two runs there is about a 2 to 1 ratio in lateral riding characteristics. It is usual for this ratio to vary for the base car from one test run to another and it is not surprising to find 3 to 1 or even a higher ratio. This means that any mechanical change made in the car under test must have a lower ride value when compared to the base car if any ride improvement results from this change on individual test runs. Therefore Fig. 1 explains why it is difficult to assess the influence of any mechanical change on car riding without the use of a base car. The importance of using a base car has

[4] Mechanical and research engineer, mechanical department, Atchison, Topeka & Santa Fe Railway Company, Topeka, Kan. Mem. ASME.

[5] Chief engineer, Railway Division, The Timken Roller Bearing Company, Canton, Ohio. Fellow ASME.

[6] Design engineer, Railway Division, The Timken Roller Bearing Company, Canton, Ohio. Affiliate ASME.

been previously recognized in the development and testing program on high-speed freight-car trucks by the Association of American Railroads and the truck manufacturers.

Five sleeping cars, A, B, C, D, and E, identical as to design and mechanical condition, were investigated for riding characteristics. The results for the lateral ride over a 10-mile run over tangent track are given in Fig. 2. A ride variation of about 6 to 1 is shown even though all five cars are presumably the same. Now it could be erroneous to determine the influence of some mechanical change on the riding of just one of these cars and then assume it applies to all five cars. These particular cars had outside swing hanger trucks, floating lateral boxes, and a 4-4-2 floor plan.

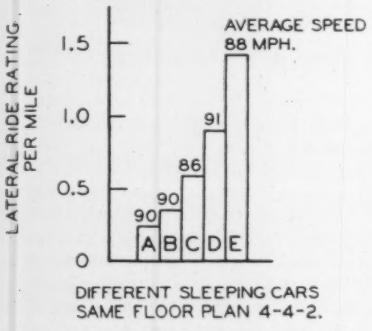

Fig. 2 Variation in ride of identical cars having outside hanger trucks and floating lateral boxes

The author gives some data to support his contention that floating lateral roller-bearing journal boxes give a better ride than if the journal boxes are nonfloating. His findings are contrary to the efforts over the past years of the AAR in trying to do just the exact opposite—reduce the amount of floating lateral in a plain bearing which was considered undesirable. Also, European railroad engineers consider a good lateral ride synonymous with no bearing lateral or nonfloating journal boxes; all their truck designs have incorporated this feature in their railway equipment.

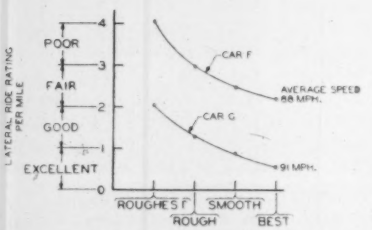

Fig. 3 Ride condition on two identical sleeping cars with nonfloating boxes and over different kinds of track

In order to investigate this question we have made road tests on passenger cars without and with floating lateral roller-bearing journal boxes to obta n the ride results in Figs. 3 and 4. Two identical sleeping cars F and G having a 6-6-2 floor plan, basic trucks, and nonfloating lateral boxes gave the spread in lateral ride shown in Fig. 3. Each point represents an average of three miles over four different tangent track conditions at high speed. Similar ride results in Fig. 4 over the same track were obtained on two other identical sleeping cars H and K having a 4-12 floor plan, basic trucks, and floating lateral boxes. All four cars F, G, H, and K were in similar good mechanical condition. The question still remains unanswered as to why presumably identical cars F and G in Fig. 3 and cars H and K in Fig. 4 should show so great a disparity in ride characteristics. Yet this variation is a practical condition and must be recognized if an actual rather than a fictitious ride improvement is to be detected by some mechanical change. It can be said, however, that some roads after having experience with floating lateral boxes are in the process of reviewing the penalty being paid for this floating feature. The increased lubrication cost and inferior bearing performance have led some users to remove the floating feature. The use of floating boxes is probably the biggest deterrent against changing AAR passenger-car lubrication Rule 7 from 90-day lubrication to a much longer period.

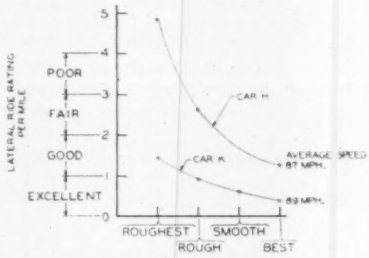

Fig. 4 Ride condition found on two identical sleeping cars with floating lateral boxes and over different kinds of track

Author's Closure

The author is indebted to the discussers for their pertinent comments.

As mentioned by Fahland and Lanning, longitudinal vibrations can be a source of annoying vibrations on some railroads. These vibrations are about 6 cps and their intensity varies with speed, resonances occurring usually at about 45 and 90 mph. More investigation into this phenomenon seems indicated. Regarding Lanning's comments on the use of central bearings on six-wheel trucks, the author reports a recent study on lightweight cars, where a shimmy on six-wheel trucks was effectively controlled by this device.

Dean's comments on the Pioneer III truck are interesting. The inboard journal feature, while serving to reduce weight, tends to hide potential maintenance trouble and this type of bearing has, for this reason, been avoided by many railroads.

Horger and Cox have reported some interesting observations on the variations experienced in testing passenger cars. While a "yardstick" car is desirable in conducting such tests, too much reliance cannot be placed on such a car as its ride may, and often does, deteriorate during a test program, rendering ride ratios with the "yardstick" as the denominator, meaningless. However, the test program covered by the author did have the same companion cars on either end throughout the program. The author declines to comment on the relative mechanical and lubrication performance of "free" vs. "fixed" lateral boxes since this is clearly in the province of the bearing manufacturers.

The author feels that if waning passenger business on the railroads is to be recaptured, riding performance must be given primary consideration.

W. E. Burdick.[7]

[7] Engineer of Tests, General Steel Castings Corporation, Granite City, Ill. Mem. ASME.

BOOKS RECEIVED IN LIBRARY

Metal Cutting Tool Nomenclature
Published 1957 by the Metal Cutting Tool Institute, New York, N. Y. 107 p., $8\frac{1}{2} \times 11$ in., paper. $4.50. A standard definition, general classifications, illustrations of various types, and a glossary of terms are provided for nine major classes of tools: Twist drills and combined drills and countersinks; reamers; counterbores and spotfacers; taps—dies and thread chasers; milling cutters; hobs; gear shaper cutters; gear shaving cutters; broaches. The book is the result of an effort to provide an effectively usable group of descriptive, unambiguous terms which at the same time conform to common usage.

Process Instruments and Controls Handbook
Edited by Douglas M. Considine. 1957, McGraw-Hill Book Co., Inc., New York, N. Y. Various pagings, $6\frac{1}{4} \times 9\frac{1}{4}$ in., bound. $19.50. A thorough and systematic treatment of the operating and design funda-

mentals of measurement and automatic control systems used in the process fields. Although specifically slanted toward the process industries, the fundamental techniques described are applicable to nonprocess fields such as medical, military, and aircraft instrumentation. Among areas covered are measurement standards, primary elements, measurement systems, indicators and recorders, automatic controllers, electric and pneumatic telemetering, fundamental principles of process control, and mathematical techniques for solving automatic control problems.

References on Fatigue, 1956
Published 1957 as Special Technical Publication no. 9-H by the American Society for Testing Materials, Philadelphia, Pa. 64 p., $8\frac{1}{2} \times 11$ in., paper. $3; Complete set, 9-B–9-H, $10. A list of about 370 references to articles published in 1956 dealing with fatigue of structures and materials. The complete set of references covers references to articles published from 1950–1956.

Safety Aspects of Nuclear Reactors
Edited by C. Rogers McCullough. 1957, D. Van Nostrand Co., Inc., Princeton, N. J. 237 p., $6 \times 9\frac{1}{4}$ in., bound. $8.50. Composed of key papers from the Geneva Conference on the Peaceful Uses of Atomic Energy, the material has been carefully selected, edited, and grouped under the following headings: normal reactor and chemical plant operations; development of radiation safety criteria; reactor accidents and their consequences; supercritical reactor experience. Since little has been available on the subject, this is a useful contribution in an area that will assume more importance as the power reactor program is developed.

Soviet Education for Science and Technology
By Alexander G. Korol. 1957, John Wiley & Sons, Inc., New York, N. Y. 513 p., $6 \times 9\frac{1}{4}$ in., bound. $8.50. A general outline of the educational system of the Soviet Union from elementary through graduate school. A considerable portion of the book is devoted to the technicum and other specialized schools which train students for work at the subprofessional level, and there is an extensive study of Soviet undergraduate higher education, with curriculums in physics and a typical major in mechanical engineering shown in detail. The author's conclusions are at variance with some of the accepted generalizations concerning Soviet education.

Stromungsmaschinen
By Carl Pfleiderer. Second Edition. 1957, Springer Verlag, Berlin, Germany. 421 p., $6\frac{1}{4} \times 9\frac{1}{4}$ in., bound. DM 36. An advanced treatment of steam, gas, and hydraulic turbines, centrifugal pumps, compressors, etc., intended to cover those principles common to all types of turbomachinery. The several sections deal with the following: Fluid mechanics of runners; design and examples of operation of runners; characteristics of single-stage machines; clearance loss and axle thrust, guiding devices and passages; special aspects of axial runners; characteristics of single and multistage compressors and turbines.

Water Waves
By J. J. Stoker. 1957, Interscience Publishers, Inc., New York, N. Y. 567 p., $6\frac{1}{4} \times 9$ in., bound. $12. A study of the mathematical theory of wave motion in liquids with a free surface and subjected to gravitational and other forces, together with applications to a wide variety of concrete physical problems. A large part of the book deals with problems the solutions of which have been found during and since World War II. Aspects investigated are the derivation of the basic hydrodynamic theory for nonviscous incompressible fluids, the approximate theory which results when the amplitude of the wave motions considered is small, problems involving waves in shallow water, and problems solved in terms of the exact theory.

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Der Bau und der Betrieb der Kupolofen
By Leopold Schmid. Second Edition. 1953–1956, Wilhelm Knapp-Verlag, Haale (Saale), Germany. 2 vols., 163 and 219 p., $6\frac{1}{4} \times 9\frac{1}{2}$ in., bound. DM 11 and DM 9.60. A concise treatment of the design and operation of cupola furnaces for the engineer or practical foundryman. Vol. 1 (1956) covers the development of the cupola furnace smelting technique, the types of furnaces, and auxiliary equipment. Vol. 2 (1953) covers raw materials and fuels, chemical and physical phenomena in furnace shafts, and the composition and measuring of the charge. Some 450 literature references are given.

Digital Computer Components and Circuits
By R. K. Richards. 1957, D. Van Nostrand Co., Inc., Princeton, N. J. 511 p., $6 \times 9\frac{1}{4}$ in., bound. $10.75. This basic text for the student or practicing engineer emphasizes basic engineering approaches to digital techniques. A wide range of components and circuits of an experimental nature is covered, as well as logical functions and digital storage, basic operations to be performed by a digital computer, and the advantages and disadvantages of various approaches to design. Design concepts are stressed rather than specific design details.

Engineered Work Measurement
By D. W. Karger and F. H. Bayha. 1957, Industrial Press, New York, N. Y. 635 p., $6 \times 9\frac{1}{4}$ in., bound. $12. A unified text that encompasses the essential principles, data, and techniques of methods-time measurement, modern time-and-motion study, and related applications engineering data with a view to developing labor standards and better manufacturing methods. The major portion of the book is devoted to the fundamentals of methods-time measurement. Terms are defined and illustrated, and special mathematics, standards, applications, and the development of training courses are covered in detail.

Engineering Materials Handbook
Edited by Charles L. Mantell. 1958, McGraw-Hill Book Co., Inc., New York, N. Y. Various pagings, $6\frac{1}{4} \times 9\frac{1}{4}$ in., bound. $21.50. A thorough reference book that emphasizes fabricated forms of materials, their physical and mechanical properties, their advantages and limitations, protection against deterioration, and increase in their stability to withstand use and abuse. The subject matter is divided into four parts: metals, inorganic materials, organic materials, and the prevention of failure. A feature of the book is the attention given to uncommon metals.

Heat Transfer
By Max Jakob. Vol. 2, 1957, John Wiley & Sons, Inc., New York, N. Y. 652 p., $6 \times 9\frac{1}{2}$ in., bound. $15. A direct continuation of volume one, this volume consists of three sections: heat radiation in spaces of simple configuration, selected fields of application, and supplements to volume one. The largest portion of the book consists of specific applications such as heat transfer in thermometry, recuperators, regenerators, cooling towers, cooling of surfaces exposed to hot gases, heat transfer through laminar boundary layer at high fluid velocity, and heat transfer in liquid metals. The concluding section brings the material in volume one up to date.

History of Hydraulics
By Hunter Rouse and Simon Ince. 1957, Iowa Institute of Hydraulic Research, State University of Iowa, Iowa City, Iowa. 269 p., $6\frac{1}{4} \times 9\frac{1}{4}$ in., bound. $5. The authors have chosen as their historical theme the formulation of the underlying principles of fluid motion. Considerable attention is given to the men who bore the brunt of the development and to their related interests and accomplsihments. In general the subject of hydraulics is not treated as an isolated phenomenon but is placed within its proper historical perspective beginning with antiquity and progressing to the twentieth century.

Human Relations in Industrial Research Management
Edited by R. T. Livingston and Stanley H. Milberg. 1957, Columbia University Press, New York, N. Y. 418 p., $5\frac{3}{4} \times 8\frac{3}{4}$ in., bound. $8.50. A collection of 27 papers from the 1955 and 1956 Industrial Research Conferences sponsored by Columbia University. The papers are directed at two audiences—people in individual research, and people studying the management of research: Part 1, the expectations and jobs of research; part 2, the individual and the research job; part 3, research organization and the management jobs; part 4, some aspects of human relations; part 5, managerial technologies.

Introduction to Heat Transfer
By Aubrey I. Brown and S. M. Marco. 1958, McGraw-Hill Book Co., Inc., New York, N. Y. 332 p., $6\frac{1}{4} \times 9\frac{1}{4}$ in., bound. $6.75. This standard text for engineering students and practicing engineers now contains two new chapters: Fluid flow in the convection process, and graphical and numerical methods for heat-conducting problems. Symbols and abbreviations have been revised in accordance with the recommended practices of the American Standards Association.

Materials Handling Handbook
Edited by Harold A. Bolz. 1958, The Ronald Press Co., New York, N. Y. Various pagings, $6\frac{1}{4} \times 9\frac{1}{4}$ in., bound. $20. Concerned with efficient and economic handling of materials in raw, in process, or finished form. Methods for analyzing handling problems are treated: Principles and techniques for effective operation and control; systems design and installation; integration of materials-handling activities with the manufacturing processes; and the design, selection, and classification of materials-handling equipment. This equipment is

analyzed in relation to the engineering specifications and the operating capabilities of each type.

Mechanical Vibrations
By Austin H. Church. 1957, John Wiley & Sons, Inc., New York, N. Y. 275 p., 6 × 9¼ in., bound. $6.75. A rigorous treatment of vibration analysis is given so that the usual problems encountered in this field may be readily solved. In addition a groundwork is laid for more advanced work in this area. Specific topics covered include forced vibrations of multimass systems, harmonic analysis, torsional critical speeds, electrical analogies, coupling action, and the balancing of angle or see engines.

Midwestern Conference on Fluid Mechanics
Proceedings of the Fifth Conference, April, 1957. Published 1957 for the Engineering Research Institute by the University of Michigan Press, Ann Arbor, Mich. 388 p., 5¾ × 8¾ in., bound. $8. A collection of 26 papers which represent basic research in many aspects of fluid mechanics. Included are papers on basic and applied problems in free surface phenomena, heat transfer and skin friction in laminar and turbulent boundary layers, stability of flows, viscosity, shock wave and dissociation effects in supersonic and hypersonic flows, and other fields.

Midwestern Conference on Solid Mechanics
Proceedings of the Third Conference, April 1957. Published 1957 for the Engineering Research Institute by the University of Michigan Press, Ann Arbor, Mich. 250 p., 5¾ × 8¾ in., bound. $5.50. Fifteen papers devoted to basic research in the area of solid mechanics cover elasticity, plasticity, properties of viscoelastic media, wave propagation, structural dynamics, stability of rotors, flutter of aircraft components, and structures. The authors are connected with governmental and industrial research laboratories.

Once Round the Sun: The Story of the Geophysical Year
By Ronald Fraser. 1957, The Macmillan Co., New York, N. Y. 160 p., 5½ × 8½ in., bound. $3.95. Because of the importance of the sun in the study of geophysics, various phases of the sun's behavior are discussed and its effect on the earth, including earthquakes, terrestrial magnetism, the movements of the oceans and the great air masses, the auroras, and the melting of glaciers. The program of the International Geophysical Year is covered in detail: The 24-hour watch on the sun, the oceanographic program and the concentration of stations throughout the earth. A two-page conclusion is a summary of what the program hopes to achieve.

Technical Report Writing
By James W. Souther. 1957, John Wiley & Sons, Inc., New York, N. Y. 70 p., 8¼ × 10¾ in., paper. $2.95. A concise, practical treatment which approaches the subject as a design problem, and which relates report form to the use to be made of the report. The major aspects of the subject are taken up in a logical manner: determining the purpose, industrial use, and audience of the report; gathering the necessary material and evaluating it; the problem of deciding what material is to be included and the order in which it is to be presented; writing the report, including preparation of the final copy.

Van Nostrand's Scientific Encyclopedia
Third Edition. 1958, D. Van Nostrand Co., Inc., Princeton, N. J. 1839 p., 8¾ × 11¼ in., bound. $30. Considerably revised, this comprehensive reference work presents some 15,000 separate topics dealing with principles and applications of the physical sciences, medicine, and technology, including nuclear science and engineering. The presentation of each topic, beginning with a simple nontechnical definition and progressing to the more advanced phases, is helpful to the general reader. In addition to the customary cross references, all terms in the main alphabetical list are printed in heavy type wherever they occur.

Advanced Dynamics
By John E. Younger. 1958, Ronald Press Co., New York, N. Y. 285 p., 6¼ × 9¼ in., bound. $8.50. Covers the dynamics of beams, rectilinear motion, angular motion, plane motion, and motion in three dimensions. Concepts used include D'Alembert's principle, Lagrange's equation of motion, moving axes, relative motion, the free-body diagram, and the ellipsoid of inertia. Numerous problems are worked out in detail to illustrate the application of principles and methods, and where possible alternate methods of solution are presented.

Applications de la Théorie du Fluage
By N. Kh. Aroutiounian. Translated from Russian by P. Mrozowica. 1957, Éditions Eyrolles, Paris, France. 319 p., 6½ × 9¾ in., bound. 4500 fr. An analytical treatment of the phenomenon of flow in solid materials, with particular reference to its relation to thermal and shrinkage stresses and deformations in massive concrete and in reinforced concrete structural elements. Theoretical aspects are dealt with in the first two chapters and design problems are considered in the later chapters.

Automation and Management
By James R. Bright. 1958, Harvard University, Graduate School of Business Administration, Boston, Mass. 270 p., 8¾ × 11¼ in., bound. $10. Three major aspects of the automation are studied extensively in this report. The first section provides a background on the nature of production-line mechanization and the growth of automaticity in manufacturing, while the second describes the automation programs of 13 plants with respect to conception, design, procurement, installation, and debugging experiences. The final section discusses the impact of automation on maintenance, the skill requirements of the work force, and management.

The Gray Iron Castings Handbook
Edited by Charles F. Walton. 1958, Gray Iron Founders' Society, Cleveland, Ohio. 607 p., 6¼ × 9¼ in., bound. $10. Provides information useful in the design, purchase, and applications of gray, ductile, white, and high alloy iron castings. Data are given on design; specifying and purchasing; properties; heat treatment in relation to improved wear resistance and strength; welding, joining, and cutting; machining and grinding; abrasive finishing; metallic and nonmetallic coatings.

Indeterminate Structural Analysis
By J. Sterling Kinney. Complete Edition. 1957, Addison-Wesley Publishing Co., Inc., Reading, Mass. 655 p., 6¼ × 9¼ in., bound. $9.50. Following preliminary theoretical material the most frequently used methods of analysis are explained. The general method of Maxwell with its modifications is presented as is the method of least work and an introduction to column analogy. Other aspects discussed are the slope deflection method, for prismatic and nonprismatic members, the method of moment distribution, influence lines, and the analysis of arches. A distinctive feature is the development of the principles involved in direct and indirect model analysis. An abridged edition for a one-semester course is available from the publisher for $7.50.

Instrumentation in Testing Aircraft
By C. N. Jaques. 1957, Chapman & Hall, Ltd., London, England. 291 p., 5½ × 8¾ in., bound. 45s. Examines the development and application of special instruments used to determine aerodynamic, structural, and aero-engine characteristics. The subject is presented in three major divisions: Basic principles, measurement of physical quantities, and data transmission and recording; including recording methods, continuous trace recording equipment, and intermittent recording equipment. Little reference is made to American equipment, and for the most part the discussion is restricted to British practice.

Introduction au Génie Nucléaire
Vol. 1: Physique et Calcul des Réacteurs Nucléaires. Vol. 2: Contrôle et Protection des Réacteurs Nucléaires. By Théo Kahan and Maurice Gauzit. 1957, Dunod, Paris, France. 388 and 396 p., 6¼ × 9¾ in., bound. 3900 fr. each. Vol. 1 of this two-volume set covers the fundamentals of nuclear physics, the basic theory of nuclear reactors, and the design and calculations of several types of reactors including brief discussion of one Russian installation. Vol. 2 deals with reactor control, and with the detection of radiation, radiation danger, and protection. A brief treatment of the liberation of energy from the fusion of light elements is appended.

Kempe's Engineer's Yearbook
Sixty-Third Edition. 1958, Morgan Brothers, Ltd., London, England. 2 vols., 4¾ × 7 in., bound. 82s.6d. A new edition of a handbook covering virtually all fields of engineering. Although all sections have been rewritten to some extent, the following areas have been extensively revised: Welding and cutting; water engineering; corrosion and protective coatings; blasting processes and new abrasive materials; aerodynamics and aircraft propulsion; electronic engineering; atomic power; heating, ventilating, and air conditioning.

Living With the Sun
Vol. 1. Published 1958 by the Association for Applied Solar Energy, Phoenix, Ariz. XII p., 60 plans, 14¼ × 14¼ in., spiral binding. $6. Sixty plans selected from entries in the 1957 international architectural competition to design a solar-heated residence. Two principal solutions to the design of solar energy units are utilized. In the first the solar collectors are assumed to be an integral part of the house, while in the second the heat-collecting mechanism is kept as a separate entity. Design notes offer an explanation of the design and proposed method of operation, with an indication of the estimated heat loss and gain.

Mechanical Refresher (Mechanics and Machine Design)
By John D. Constance. Second Edition. 1958, published by the author, 625 Hudson Terrace, Cliffside Park, N. J. Various pagings, 10¾ × 8½ in., paper. $3. A review manual for the professional engineer's license candidate. Although the basic theory is summarized, the main emphasis is on the solution of problems taken from past examinations which serve to illustrate applications of the theoretical aspects. This newly revised edition has been brought up to date by the inclusion of new

material to correspond with examination trends such as mechanical vibrations, equilibrium of spatial force systems, dynamics of a particle, impulse and momentum, and other topics.

Metallurgical Aspects of the Control of Quality in Nonferrous Castings

Published 1957 by the Institute of Metals, London, England, as Monograph and Report Series No. 22. 148 p., $8^3/_4 \times 11^1/_2$ in., bound. $5.50 Metallurgical principles, the role of statistical methods, pressure-die castings, and nondestructive testing are studied in relation to quality control in nonferrous castings. Alloys studied from this point of view include aluminum alloys, copper-base, magnesium-base, and nickel-alloy sand castings. A general discussion of the papers is provided.

Motion and Time Study

By Ralph M. Barnes. Fourth Edition. 1958, John Wiley & Sons, Inc., New York, N. Y. 665 p., $6 \times 9^1/_4$ in., bound. $9.25. In addition to the basic material contained in previous editions of this work, five new chapters have been added dealing with motion study, mechanization, and automation; mechanized time study and electronic data processing; systems of motion-time data; work sampling; evaluating and controlling factors other than labor. New material is included on developments in the industrial use of pulse rate as an index of physical activity, and all known systems of motion data are outlined and described.

Production Planning and Inventory Control

By John F. Magee. 1958, McGraw-Hill Book Co., New York, N. Y. 333 p., $6^1/_4 \times 9^1/_4$ in., bound. $7.50. Covering the field from the viewpoint of operations-research thinking, preliminary chapters outline the functions of inventories and planning and of the policies and costs bearing on them, while the latter portion of the volume deals with the design of planning and control systems. Specific applications include the use of servotheory concepts to control production fluctuations, linear programming in seasonal planning, new scheduling devices, methods for very short-run forecasting, and the basic stock concept for controlling production and distribution through several stages.

La Propulsion par Fusées

By Marcel Barrère and others. 1957, Dunod, Paris, France. 389 p., $6^1/_4 \times 9^3/_4$ in., paper. 5600 fr. A thorough treatment of the theory and practice of rocket propulsion. The beginning chapters deal with the general aspects of energy production, propulsion-tube theory, and the characteristics of rocket motors. The characteristics, manipulation, and combustion of both solid and liquid propellants are next considered in detail, including the fuel systems. Both low and high-frequency instability of combustion are treated, and the last three chapters are devoted to the exterior ballistics of rockets.

Queues, Inventories and Maintenance

By Philip M. Morse. 1958, John Wiley & Sons, Inc., New York, N. Y. 202 p., $6 \times 9^1/_4$ in., bound. $6.50. The first of three projected volumes this volume is an introductory monograph to the subject of queuing. It treats general queuing problems and discusses the effect of change of arrival and service distributions on queuing results. Queuing problems are dealt with from the standpoint of the Kolmogorov equations relating the probabilities, and specific applications such as those relating to repair and maintenance of machinery are analyzed and solved. The book is No. 1 in the series, Operations Research Society of America, Publications in Operations Research.

Satellites and Spaceflight

By Eric Burgess. 1957, The Macmillan Co., New York, N. Y. 159 p., $5^3/_4 \times 8^1/_2$ in., bound. $3.95. The development of the earth satellite is presented with details on construction, instrumentation, launching procedure, transmission of data, and flight orbit. This is followed by a consideration of the spaceflight program and the physiological and psychological problems connected with manned rockets and the establishment of a manned station in space. The concluding portion of the book examines the possibility of expeditions to the moon and the planets.

Studies in Ancient Technology

Vol. 5, by R. J. Forbes. 1957, W. S. Heinman, 400 East 72nd Street, New York 21, N. Y. 235 p., $6^1/_2 \times 10$ in., bound. $6.50. A detailed study of early manufacturing processes. Leatherworking is covered from prehistoric tanning to its use as footwear in Rome and Greece and as parchment. Sugar is studied in relation to honey, its chief source in antiquity, although reference is made to various substitutes used. The final portion of the book deals with glass technology, and includes an extensive study of the chemical composition of glass within the periods touched upon.

Symposium on Thermal Conductivity Measurements and Applications of Thermal Insulations

Published 1957 as Special Technical Publication No. 217 by the American Society for Testing Materials, Philadelphia, Pa. 86 p., $6^1/_4 \times 9^1/_4$ in., bound. $2.75. Six papers dealing with the development of specifications and methods of test for thermal insulating materials. Aspects included are analyses and experimental procedures by which criteria may be developed, improvements and modifications of the apparatus within the scope of the test method, the effect of moisture on thermal insulation, and the use of thermal insulation for underground piping.

Technische Schwingungslehre

By Erhard Hübner. 1957, Springer-Verlag, Berlin, Germany. 322 p., $6^1/_2 \times 9^1/_2$ in., bound. DM 29.40. A treatment of mechanical vibrations which aims to fill the middle ground between the theoretical treatise and the elementary textbook. Main headings are as follows: dynamics of vibration; vibration systems with several degrees of freedom; homogeneous systems with distributed mass and uniform elasticity; electrical analogy; elimination or suppression of vibration; measurement methods; nonlinear vibrations—single degree of freedom.

Thermodynamics of Heat Power

By Virgil M. Faires. 1958, The Macmillan Co., New York, N. Y. 432 p., $6^1/_4 \times 9^1/_2$ in., bound. $8. Although descriptive material has been included, major emphasis is on the development and application of theory, particularly as applied to steady flow systems. Topics included are ideal gases; compressors; turbines; internal-combustion engines; liquids and vapors; heat exchangers; nozzles and fluid flow; reciprocating steam engines; mixtures; fuels and combustion; pumps and fans. The book is a revised edition of the author's "Theory and Practice of Heat Engines."

Vibration Control

By John N. Macduff and John R. Curreri. 1958, McGraw-Hill Book Co., Inc., New York, N. Y. 465 p., $6^1/_4 \times 9^1/_2$ in., bound. $9. Presents a broad coverage of the subject ranging from elementary vibration theory to specific areas such as rotor balancing, vibration isolation, steady state and transient response, and sound-control problems. Diverse means of analysis are studied including the impedance method for steady-state vibration, the operational calculus and electronic analog computer for transient analysis, methods for analyzing nonlinear systems, and possible uses of the electronic analog simulator.

ASTM Standards on Petroleum Products and Lubricants

Published 1957 by the American Society for Testing Materials, Philadelphia, Pa. 1103 p., 6×9 in., paper. $8. Contains 188 standards of which 43 are new, recently revised, or have had their status changed. Among the major areas covered are crude petroleum; natural gases; butadiene; motor and aviation fuels; petroleum lubricants; diesel fuels; and lubricating, industrial, and turbine oils.

Air Conditioning, Refrigerating Data Book: Design Volume

Tenth Edition. 1957, American Society of Refrigerating Engineers, New York, N. Y. Various pagings, $6^1/_2 \times 9^1/_4$ in., bound. $10 A new edition of a handbook containing data on all phases of the refrigeration and air-conditioning industry. The following areas have received particular attention in the course of revision: moisture; thermal insulation and water-vapor barriers; absorption and steam jet units; testing and charging; refrigerant tables and charts; codes, standards, and sponsors. As in previous editions a classified directory for the refrigeration industry is included.

American Power Conference Proceedings, Volume XIX, 1957

Published 1957 by the Illinois Institute of Technology, Chicago, Ill. 746 p., $6^1/_4 \times 9^1/_4$ in., bound. $8. Papers emphasizing broad aspects of technical development. A wide variety of topics are presented including steam and gas turbines, industrial power plants, condensers and feedwater circuits, extra-high voltage systems, electrical distribution, computers and network analyzers, nuclear energy, and water technology.

An Analysis of the Wood-Cutting Process

By Norman C. Franz. Published 1958 for the Engineering Research Institute by the University of Michigan Press, Ann Arbor, Mich. 152 p., $8^1/_2 \times 11$ in., paper. $4.50. A study of the machining of wood with saws, surface planers, and coated abrasives. It begins with a description of the experimental procedures and interpretive techniques used, including that of photographic analysis. The results and analysis of observational studies, of tool-force studies, and of mechanical-properties tests, are then given. A concluding unit discusses the mechanics of chip formation.

Basic Feedback Control System Design

By C. J. Savant. 1958, McGraw-Hill Book Co., Inc., New York, N. Y. 418 p., $6^1/_4 \times 9^1/_4$ in., bound. $9.50. Servomechanism theory and design are presented from a fundamental point of view by means of practical examples. The approach utilzed is based on a combination of the root-locus and frequency-analysis method, and while emphasis is on linear servomechanism design, nonlinear servomechanism analysis is included. Along with basic material, information is provided on components, gyroscopes, force-balance transducers, and inertial navigation.

Current Engineering Events, News, and Comment

E. S. NEWMAN
News Editor

THE ROUNDUP

NATIONWIDE SUPPORT

FOR THE UNITED ENGINEERING CENTER

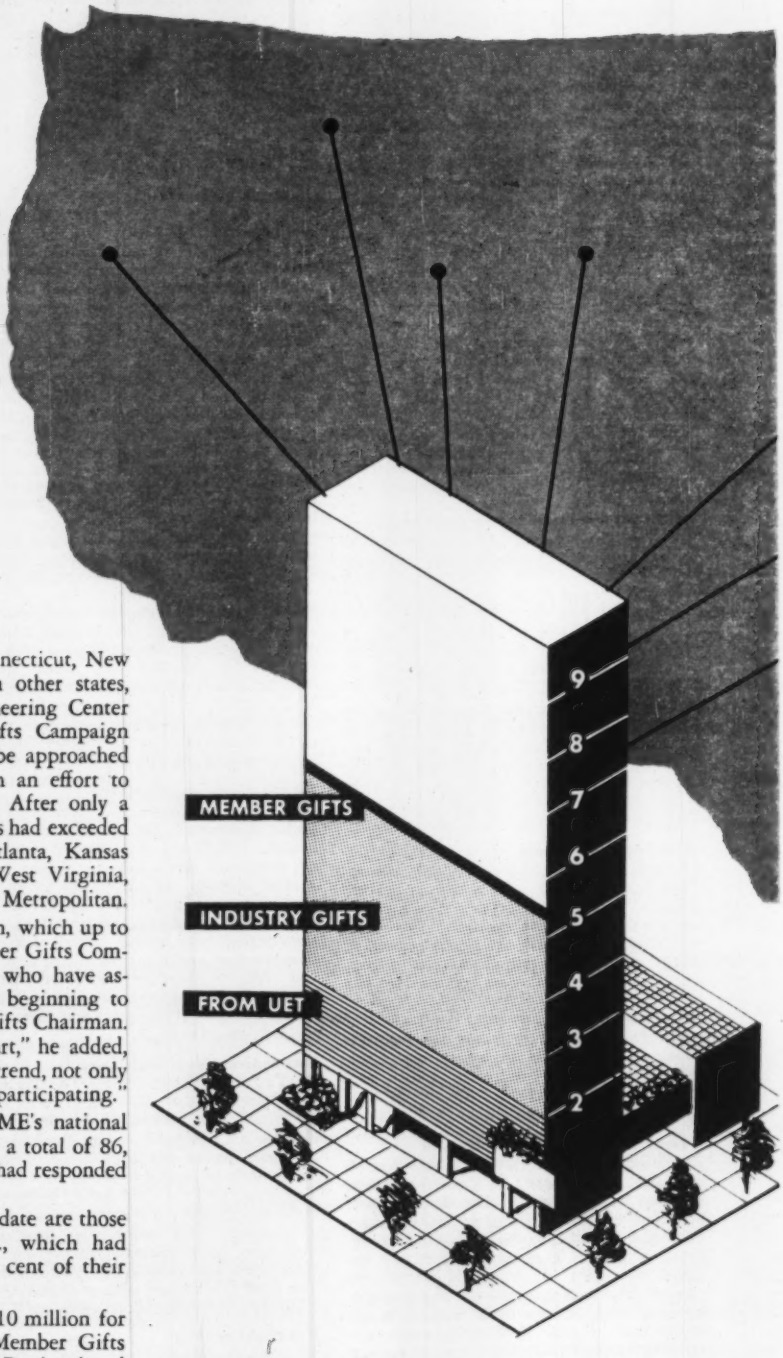
From Georgia, Missouri, California, Connecticut, New York, Colorado, Pennsylvania, and a dozen other states, funds to help build the new United Engineering Center are pouring in as the ASME Member Gifts Campaign swings into high gear. Every member will be approached before the target date of Nov. 30, 1958, in an effort to reach ASME's $800,000 member-gift quota. After only a few weeks of active campaigning, nine Sections had exceeded ten per cent of their quotas. They are: Atlanta, Kansas City, Nebraska, New Haven, Schenectady, West Virginia, Central Iowa, Canton-Alliance-Massillon, and Metropolitan.

"Careful planning and proper organization, which up to now have absorbed the energies of the Member Gifts Committee and the eight Society Vice-Presidents who have assumed responsibility for the campaign, are beginning to bear fruit," says William F. Ryan, Member Gifts Chairman. "Despite what might appear to be a slow start," he added, "recent weekly returns show a steady upward trend, not only in dollar receipts, but in number of members participating."

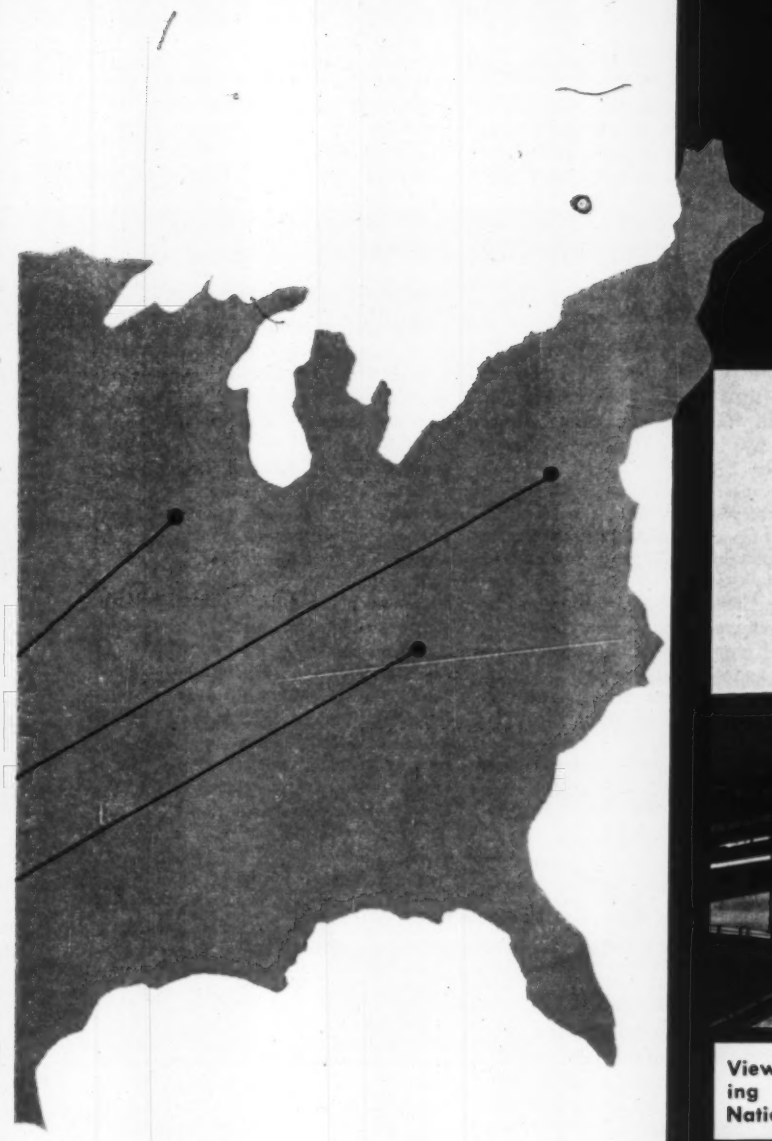
Only two weeks after completion of ASME's national Member Gifts organization, 30 Sections out of a total of 86, representing all eight Regions of the Society had responded to the appeal for funds.

Among the most heartening responses to date are those from Atlanta, Ga., and Schenectady, N.Y., which had reached, respectively, 86 per cent and 66 per cent of their Section quotas by August 1.

Final step in a three-stage effort to raise $10 million for the new United Engineering Center is the Member Gifts Campaign now under way. Working through Regional and Sectional organizations, volunteers are communicating with every ASME member to secure financial support for the Center.



Of the $10-million goal for construction of the new United Engineering Center, funds available as of Aug. 1, 1958, are shown above

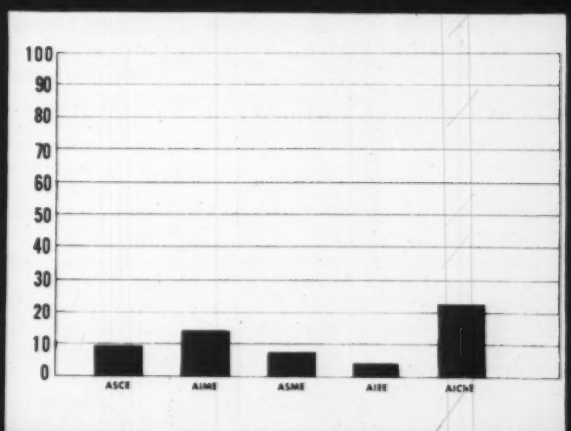


the platform and symbol

"The engineer needs an adequate platform from which to expound his efforts as a creator of economic and social values. He needs a symbol of his dynamic purpose. "The new United Engineering Center, a focus of life for many engineering societies, will provide the platform and the symbol."

C. F. Kettering
Honorary Chairman
Member Gifts Campaign

View from site of United Engineering Center facing south shows 47th Street and the United Nations buildings



Results of Member Gifts Campaign conducted by five Founder Societies, in terms of per cent of quota reached by Aug. 1, 1958

Together, the five Founder Societies expect to reach their $3-million quota by Nov. 30, 1958. ASME's share is $800,000. The parallel industry campaign, which began last winter, has already exceeded 68 per cent of its $5-million quota and substantial contributions from industrial concerns are continuing. Another $2 million is available from present assets of The United Engineering Trustees.

In keeping with its name the new Center is to be the center of the engineering profession represented by the participating societies. As such, it will improve service to members, facilitate co-operation among societies, provide distinct economies through joint operations, and advance the individual engineer's continuing quest for knowledge.

Symbol of a proud profession, the United Engineering Center will, at the same time, be an entirely functional and useable building.

COMING MEETINGS

Nuclear Reactor Technology

ANALYTICAL chemistry in nuclear reactor technology will be the subject of a conference to be held September 29 to October 1, at Gatlinburg, Tenn., under the auspices of the Oak Ridge National Laboratory. Two three-hour sessions of technical presentations will be held each day at the Gatlinburg Civic Auditorium.

This meeting is the second in a series. The first conference dealt specifically with a review of recent developments in the analytical chemistry of important reactor materials. At the forthcoming conference, these discussions will be continued, but only in respect to those facets of analytical chemistry which relate specifically to preoperational and operational methods of analysis.

For further information write: C. D. Susano, Oak Ridge National Laboratory, P.O. Box Y, Oak Ridge, Tenn.

"Imagineering" in Space

"IMAGINEERING to Meet Tomorrow's Needs," will be the theme of the Fourth Joint Military-Industry Packaging and Materials Handling Symposium, to be held in Washington, D. C., September 30 to October 2.

Outer space, a definite part of tomorrow's everyday life, and the technical aspects of providing logistic support for space operations, will be but two of the many important topics discussed. Packaging and handling for shipment, on-the-job development of capable personnel, practical economics of automatic warehouses, and new material handling and packaging equipment and supplies are other subjects on the program.

The symposium was originated four years ago in response to a need for closer co-ordination between government agencies and industry. This year, the symposium will be sponsored by the Department of the Navy in co-operation with the Departments of the Army, Air Force, and Commerce.

Inquiries should be directed to the Head, Packaging Section, Supply Programs Division, Office of Naval Material, Washington 25, D. C.

Instrumentation-Automation

"INSTRUMENTATION in the Space Age" is the theme of the 13th annual Instrument-Automation Conference and Exhibit to be held September 15–19 in Convention Hall, Philadelphia, Pa. The Instrument Society of America, the only technical group devoted exclusively to the technology of instrumentation and automatic controls, has planned a series of clinics, workshops, and technical sessions for the exhibit week.

A computer clinic and a maintenance clinic are planned as are several workshops on data handling, maintenance management, sales engineering, and education. Technical sessions will be conducted by leading authorities covering every phase of the industry.

Complete programs may be obtained from William Kushnick, executive director, Instrument Society of America, 313 Sixth Avenue, Pittsburgh, Pa.

It Is Now Engineers Joint Council, Incorporated

ACCEPTANCE of the Articles of Incorporation, granted Engineers Joint Council by the Secretary of State, New York, on March 20, 1958, has been voted by the majority of the member societies of Engineers Joint Council. On July 10, the incorporation of EJC was formalized at a special meeting of the Board of Directors and EJC became a membership corporation. Corporate officers elected included: President, Enoch R. Needles; Vice-President, O. B. J. Fraser; Treasurer, E. Lawrence Chandler; Secretary, E. Paul Lange; and Assistant Secretary, L. K. Wheelock.

Commenting upon the change of Engineers Joint Council from a voluntary unincorporated association to its corporate status, President Needles said: "The incorporation of Engineers Joint Council strengthens the activities of EJC by presenting a more solid and formal organization than hitherto. It is a definite step toward unity in the engineering profession and the actions of EJC as a 'legal person' will carry the added weight of a homogeneous group."

At the July 10 meeting, the Board of Directors confirmed the election of the American Institute of Plant Engineers as an associate member, effective July 10. This brings the number of societies in Engineers Joint Council to nineteen.

LITERATURE

Automation

"AUTOMATION and Management," by Prof. James R. Bright, Mem. ASME, Harvard Business School, presents briefly the results of an extensive and thorough study of the complex facet of business economics as it affects management. In the *Industrial Bulletin* of Arthur D. Little, Inc., the book is described as a significant contribution to the crowded but arid field of automation literature and we further quote as follows:

"To measure the consequences of automation, one must first decide what it is that is being measured, and identification is difficult when definitions of automation are so numerous. Professor Bright quotes 24—all different—which were voiced at the 1955 Congressional hearings on the subject. He concludes that 'automation' is a value word, not a content word; 'it has become a synonym for doing things more automatically than customary.'

"To justify this rather broad definition, Professor Bright points to the evolutionary character of mechanization and the complexity of a manufacturing process. Mechanization has level, span, and penetration—qualities which defy the use of a simple label such as automation. He suggests 17 levels of mechanization from the completely manual operation to the self-controlled machine that responds to changes in the environment by modifying its own action accordingly. Employing these categories, each step of a process can be analyzed, and a 'mechanization profile' plotted.

"Having disposed of 'automation' as a meaningful term, or as a simply measurable phenomenon, Professor Bright turns to an examination of actual experiences with advanced mechanization and the managerial problems they produced. He covers such topics as downtime (when the machine is not working, but should be), the skills of the work force, personnel problems, the effect of automation on sales, and its impact on management. The areas of difficulty are made apparent, but, as one might expect, no general pattern emerges; like the machinery in-

volved, the problems management must solve are unique to the specific plant."

Published by the Harvard University Press, the 270-page book costs $10.

Materials Research and Mechanical Development

A 16-PAGE report, presents 18 case histories which demonstrate how materials research and mechanical development have been employed to advance the performance and reliability of mechanical components, systems, and structures. These case histories have been selected to cover a wide range of industries, products, and project scope. The report is available through Lessells and Associates, Inc., 916 Commonwealth Avenue, Boston 15, Mass.

Atomic Energy

● A SURVEY, *State Activities in Atomic Energy*, published by the Atomic Industrial Forum, indicates that as of July 1, 1958, seven states have adopted comprehensive radiation protection codes. The 44-page book is a state-by-state cumulative summary of the regulatory and developmental actions by state legislatures and executive agencies affecting atomic energy. The survey includes references to such actions by municipalities and related activities of the Atomic Energy Commission, other Federal government agencies, and various national and regional organizations. A selected chronological bibliography on the role of the states in atomic-energy development is included. The book is available at $3 a copy from the Publications Department, Atomic Industrial Forum, 3 East 54th Street, New York 22, N. Y.

● THE Forum also has published a preliminary report on the international aspects of financial protection against atomic hazards. The report gives the preliminary results of a study to find practical means to provide financial protection to the public and to atomic industry, here and in other countries, against the risk of a nuclear accident. Copies cost $1 and may be obtained from the AIF.

New Journals

WEAR, a new international journal on fundamentals of friction, lubrication, wear, and their control in industry proposes to provide the latest advances in the knowledge of wear and its prevention. Its first issue presents six articles, theoretical and practical, on various aspects of the wear problem. Through its section, "Literature and Current Events," *WEAR* hopes to build up gradually an information center on the many aspects of wear. This section will include systematic abstracts on current literature; a selected number of authors' abstracts; bibliographies on work in specialized fields or on languages other than those in the journal; recent events; forthcoming events; and notes on contributors.

Papers are published in English, French, and German. There are to be six issues to the volume, approximately 500 pages. Subscription price is $15 per volume and should be addressed to the Elsevier Publishing Company, Spuistraat 112, Amsterdam-C, The Netherlands.

MEETINGS OF OTHER SOCIETIES

Sept. 15–18

American Rocket Society, Inc., fall meeting, Hotel Statler-Hilton, Philadelphia, Pa.

Sept. 15–19

Instrument Society of America, instrument-automation conference and exhibit, Philadelphia Convention Hall, Philadelphia, Pa.

Sept. 15–20

International Congress on Large Dams, sixth annual, Hotel Statler-Hilton, New York, N. Y.

Sept. 21–24

American Institute of Chemical Engineers, national meeting, Hotel Utah, Salt Lake City, Utah

Sept. 22

International Atomic Energy Agency, second general conference, Geneva, Switzerland

Sept. 22–24

Standards Engineers Society, annual meeting, Benjamin Franklin Hotel, Philadelphia, Pa.

Sept. 22–25

International Union for the History and Philosophy of Science, symposium on scientific instruments of the 16th to the 19th century, Frankfurt-am-Main, Germany

Sept. 23–26

Association of Iron and Steel Engineers, annual convention and iron and steel exposition, Cleveland Public Auditorium, Cleveland, Ohio

Sept. 24–25

The Institute of Radio Engineers, annual symposium on industrial electronics, Rackham Memorial Auditorium, Detroit, Mich.

Sept. 29–Oct. 3

Society of Automotive Engineers, national aeronautic meeting, aircraft production forum, and aircraft engineering display, Ambassador Hotel, Los Angeles, Calif.

Sept. 30–Oct. 2

TAPPI, ninth testing conference, General Ogelthorpe Hotel, Savannah, Ga.

Sept. 30–Oct. 2

International Standardization Organization, Technical Committee 46 on Documentation, The Hague, Netherlands

Oct. 5–8

American Institute of Mining, Metallurgical, and Petroleum Engineers, fall meeting, Houston, Texas

Oct. 7–8

Institute of the Aeronautical Sciences, CAI-IAS 1958 joint meeting, Chateau Laurier, Ottawa, Canada

Oct. 8–11

Scientific Association for Aeronautics, annual meeting, Stuttgart, Germany

Oct. 13–15

American Institute of Electrical Engineers, machine tool conference, Statler-Hilton Hotel, Hartford, Conn.

Oct. 13–17

American Society of Civil Engineers, annual convention, Hotel Statler-Hilton, New York, N. Y.

(For ASME Coming Events, see page 109)

I. MECH. E. MEETINGS

Sept. 23–25

International Conference on Gearing, I. Mech. E., London

Oct. 28

Symposium on Aluminum Pressure Vessels, I. Mech. E., London, England.

▶ *Note:* The foregoing calendar of The Institution of Mechanical Engineers (Great Britain) meetings is published as a service to members of ASME. Further information relating to complete programs and available papers may be obtained from The Institution of Mechanical Engineers, 1 Birdcage Walk, Westminster, London, S. W. 1, England. Preliminary programs also are published in *The Chartered Mechanical Engineer* (I.Mech.E.) which is on file in the Engineering Societies Library, 29 West 39th Street, New York 18, N. Y., and other libraries throughout the United States and Canada.

Notes on Society Activities and Events

E. S. NEWMAN
News Editor

THE ASME NEWS

Latest Information on Quarterly Transactions of the ASME

THE Transactions of the ASME, which contain technical papers of permanent interest approved for publication by sponsoring organizations of the Society will be published under a new plan. The plan, developed by the Publications Committee and formally approved by the Board on Technology and the Council, provides for grouping of the papers in a series of four quarterlies which will be published beginning in January, 1959. (See MECHANICAL ENGINEERING, May, 1958, p. 55, and June, 1958, pp. 128–129. —Editor.)

Thus the transactions will include, in addition to the existing *Journal of Applied Mechanics*, the *Journal of Basic Engineering*, *Journal of Engineering for Power*, and *Journal of Engineering for Industry*.

The *Journal of Applied Mechanics* will be published, as in the past, in the months of March, June, September, and December; the *Journal of Basic Engineering*, in January, April, July, and October; the *Journal of Engineering for Power*, in February, May, August, and November; and the *Journal of Engineering for Industry*, in March, June, September, and December. The annual subscription price of these journals, which appears on the Annual Dues Statement, will be as shown in the table.

The individual price of a single issue is $1.50 to members and $3 to nonmembers.

	ASME Members of Any Grade		Nonmembers		Agency	
	Domestic	Foreign	Domestic	Foreign	Domestic	Foreign
Any one journal	$ 5.00	$ 5.50	$10.00	$10.50	$ 8.00	$ 8.50
Any two journals	9.00	10.00	18.00	19.00	14.40	15.40
Any three journals	12.50	14.00	25.00	26.50	20.00	21.50
All four journals	15.00	17.00	30.00	32.00	24.00	26.00

Since ASME members subscribe on a fiscal-year basis, October through September, and since the new journals will not be available until January, 1959, it has been decided to forward the October, November, and December, 1958, issues of *Transactions of the ASME* and *Journal of Applied Mechanics* to all member subscribers. The three issues will be forwarded even though a member may not have renewed his subscription for the coming fiscal year.

A member's subscription must be entered before Jan. 1, 1959, in order to avoid any interruption in service to the subscription. Members whose subscriptions are entered after Jan. 1, 1959, will be forwarded the back issues and will continue to receive, without interruption, whatever journals were requested until September, 1959.

Nonmember subscriptions may be entered on the basis of $1 per issue until December, 1958, and from January, 1959, at the new rate.

ASME Technical Paper Pamphlet Prices Increased

ASME technical paper pamphlets will cost 40 cents each to members and 80 cents to nonmembers beginning with all those numbered 58—A-00; that is, all the preprints beginning with the 1958 ASME Annual Meeting. All preprints of technical papers with numbers issued prior to this series will be sold at the old price of 25 cents to members and 50 cents to nonmembers.

After Jan. 1, 1959, the price for all papers then in stock will advance to the new price.

All coupons outstanding will be good for any individual paper at the present price or at the new price.

Division conferences scheduled up to December 9 of this year will have serial numbers earlier than the papers for the Annual Meeting and will, therefore, be handled at the old prices.

Books of ten coupons will be sold starting Oct. 1, 1958, at $3 to members and $6 to nonmembers. Special consideration has been given to members who may consider that the increase in price may work a hardship, whereas, in fact, any member can purchase any number of papers for 30 cents if he will simply avail himself of coupon books.

Members of companies wishing to order more than one copy of a paper after the meeting at which a paper has been presented will be required to pay the nonmember rate, that is 80 cents less 20 per cent or 64 cents. This does not preclude special sales prices for wholesale quantities when a reprinting may be involved. Furthermore, member and nonmember coupons for any number of copies of the same or several papers will be honored.

NEW LOOK FOR 1958 ASME ANNUAL MEETING

SOMEONE has said that traditions are meant to be broken. It was a thought like this that prompted the ASME Meetings Committee to ask itself, are the traditions that have grown up around the ASME Annual Meeting inviolable?

Streamlined Banquet

Over the years many members have complained about the annual banquet on two counts: It was too "stuffy" for some and it took place at the same time as a banquet very important to executives of industries supplying the Armed Forces. Resolving the time conflict was not difficult, for the decision by the American Rocket Society to hold their annual meeting earlier this year made available the Thursday night spot previously used by ARS.

By definition a banquet is a feast, often ceremonious and followed by speeches. Then why not more festivity and less of the formal strait-laced introduction of distinguished guests and presentation of honors and awards? As a banquet speaker this year the Meetings Committee has chosen Dr. John Furbay, an extremely gifted and widely traveled lecturer, with a timely message.

With the co-operation of Council and the Board on Honors, the Meetings Committee has arranged to limit honors presentation during the annual banquet to the ASME Medal and certificates of Honorary Membership. Seating this year will be limited to the capacity of the Grand Ballroom in the Statler-Hilton. With a considerably shorter banquet program members will find it satisfying to spend more time socially with the honored guests and at the dancing party that will follow in the Georgian Room.

Evening Sessions Restyled

Attendance at night sessions at recent Annual Meetings has fallen off, partly because out-of-town members wish to enjoy the sights and nightlife of New York City. Recognizing this, the Meetings Committee has eliminated all technical sessions on Monday evening, leaving members free to enjoy the town. On Tuesday and Wednesday evenings there will be a maximum of four technical sessions each night. These sessions will be cosponsored by the Metropolitan Section of ASME, which this year is Host Section for the Annual Meeting. Incidentally, these evening sessions will be selected to cover subject matter of exceedingly broad technical interest, including at least one session each by the Power Division, the Management Division, the National Junior Committee, and the Machine Design Division. For those whose evening interests are more social than technical, the Woman's Auxiliary has arranged for a nightclub tour on Tuesday and a theatre party to "My Fair Lady" on Wednesday.

Other Events

One not so old tradition that the Meetings Committee has supported over the past decade is the President's Luncheon which will be held as usual on Monday. ASME President James N. Landis will present an appraisal of the year in society activities.

Other featured speakers during the meeting will be Joseph W. Barker, past-president of ASME, who will deliver the Roy V. Wright lecture on citizenship responsibilities and Walter E. Boveri who will present the Towne Lecture.

Those members and their wives planning to arrive in New York on Sunday will have an opportunity, as in the past, to get acquainted at an Early Bird Party in the afternoon. Another high light of the social program is the Tea Dance which this year will be held on Tuesday afternoon to eliminate conflict with the Business Meeting. An interesting selection of plant trips is also being planned.

General Arrangements Chairman for the meeting is Arthur M. Perrin, immediate past chairman of the Metropolitan Section, who will be assisted by U. A. Rothermel, chairman of the Students Aid Committee; J. T. Vollbrecht, chairman of the Plant Trips Committee; Mrs. Erik Oberg, chairman of the Woman's Committee; and H. C. Wheaton, chairman of Banquet Committee. The ASME Meetings Committee is composed of Glenn R. Fryling, chairman; Robert E. Jonelis and Bruce M. Bailey, Junior Representatives; W. Burdette Wilkins, Arthur M. Gompf, H. N. Muller, Jr., and Kenneth L. Selby.

Early Commitments Promise Big National ASME Power Show

MORE than 200 manufacturers of power and allied equipment have contracted for space in the 23rd National Exposition of Power and Mechanical Engineering. The Exposition will be held at the New York Coliseum, Dec. 1 to 5, 1958, and the heavy volume of early commitments represents a massive investment in the potential market.

As heretofore, the display will be staged under the auspices of The American Society of Mechanical Engineers, whose 78th annual meeting will be in session at the Statler-Hilton Hotel, New York City, November 30 through December 5.

A feature of this year's display will be a number of exhibits of heavy equipment, built to customer specifications. One will be possibly the heaviest single piece of apparatus ever on view at one of these shows. It is a giant feedwater heater, made in California for a power plant located in New England; weight 36,000 lb.

Announcement has been made of the Advisory Committee for the current Exposition with Joseph Pope as chairman and John H. Lawrence vice-chairman.

Members of the Committee include: Cecil Boiling, president, American Society of Refrigerating Engineers; F. L. Bradley, consultant, Stone & Webster Engineering Corp.; Chester R. Earle, editor, *Power Engineering*; M. J. Goglia, dean of engineering, Notre Dame University; Kilshaw M. Irwin, vice-president in charge of engineering, Philadelphia Electric Company; C. E. Morrow, assistant superintendent of construction, Western Electric Company; George A. Orrok, Boston Edison Company; E. R. Queer, president, American Society of Heating and Air-Conditioning Engineers; L. N. Rowley, editor and publisher, *Power*; C. J. Sibler, chief engineer, West Virginia Pulp & Paper Company; J. F. Downie Smith, vice-president, research and development, Carrier Corporation; and A. Bowman Snavely, chief engineer, Hershey Chocolate Corporation.

Representatives of the ASME on the Advisory Committee include: J. N. Landis, ASME President; also H. R. C. Carlson, The Carlson Company; E. W. Jacobson, chief design engineer, Gulf Research & Development Company; R. B. Smith, vice-president, The M. W. Kellogg Company; and G. B. Warren, Turbine Division, General Electric Company—all of whom are members of the Board on Technology. T. F. Perkinson, chairman, Board on Technology; also G. R. Fryling, chairman, Meetings Committee; and O. B. Schier, II, secretary of the Society.

The Arrangements Committee for the 1958 National Power Conference to be held September 28–October 1, at the Hotel Statler in Boston, Mass., are, *front row left to right,* R. B. Meader, Publicity; W. E. Hopkins, Technical Events; F. B. Haeussler, vice-chairman; E. A. Barry, General Chairman; L. J. Weed, Finance, vice-chairman, Alton Kirkpatrick, Secretary; C. R. Westaway, Hotel Reservations; *rear row left to right,* N. Stadtfeld, Jr., Hotel Reservations, vice-chairman; H. W. Kinsel, Registration, vice-chairman; S. S. Perry, Reception, vice-chairman; R. R. Peatfield, Printing and Signs; K. G. Barnhill, Publicity, vice-chairman; W. Boynton, editor, ASME PINION; S. B. Farnham, Technical Events, vice-chairman; and W. S. C. Henry, Plant Trips.

Economical Power Generation in High-Cost Fuel Areas Keynotes ASME-AIEE Power Conference in Boston

BOSTON, MASS., the Hub City, home of the bean and the cod, will play host to the second National Power Conference, a joint meeting of The American Society of Mechanical Engineers and the American Institute of Electrical Engineers. The 1958 National Power Conference opens with an early bird registration on Sunday, September 28, at the Hotel Statler. It closes Wednesday, Oct. 1, 1958.

The theme of the meeting, "Economical Power Generation in High Fuel Cost Areas," is to keynote the three-day meeting. The first conference was held in Allentown, Pa., last October and featured papers on the monotube boiler. This year, 15 New England colleges and the Electric Council of New England are co-operating sponsors.

Program Features

The three-day conference will feature 19 technical papers, two luncheon meetings, a buffet supper, a banquet, and five or more plant trips. Some of the technical session topics include: Steam-power plant design, current thinking in large steam-turbine-generator design, boiler feed-pump drive applications, nuclear power, marine power, power transmission, industrial power, steam-generator design, and unit tripping.

The younger members and student members should find Session IV on "Career Possibilities for Young Engineers," on Monday night, thought-provoking and enlightening. William F. Ryan, past-president and Hon. Mem. ASME, will act as chairman assisted by Mark L. Ireland, Jr., of Newport News Shipbuilding and Dry Dock Company.

J. H. Keenan, Fellow ASME, head of M.I.T.'s mechanical-engineering faculty will present a paper entitled "The Graduate Engineer in the Power Industry," and the head of the Department of Electrical Engineering at M.I.T., Gordon Brown, will discuss "Expanding Horizons for the Graduate Engineer in Electric Power." In addition, F. A. Kramer, Public Service Electric and Gas Company, Newark, N. J., will talk on "Power and Growth: The Challenge and the Promise," and V. F. Estcourt, Fellow ASME, Pacific Gas and Electric Company, San Francisco, Calif., will speak on "An Engineering Career in the Power Field."

The presentation papers will be divided among principal manufacturers of power-plant equipment, consulting engineers, actual users, and representatives of engineering education. Both sponsoring societies plan to bring to the conference outstanding speakers in all fields.

The Monday luncheon will have as its honored guest and principal speaker James N. Landis, ASME President, and at the Wednesday luncheon, W. J. Barrett, past-president of AIEE will be the honored guest.

Women's Program

The Woman's Auxiliary to the ASME, Boston Section, and the Ladies of the AIEE, Boston Section, have co-operated with the Arrangements Committee under the chairmanship of Edward H. Barry of Stone & Webster and F. B. Haenssler of General Electric, vice-chairman.

Sunday afternoon, September 28, there will be a social hour for the conferees and their wives in Parlors B and C from 4:00 to 6:00 p.m.

Tuesday morning, a bus tour of historic Boston, Concord, Lexington, and other nearby points of interest, has been arranged, followed by a sea-food luncheon at one of the North Shore's best dining rooms.

Technical Sessions

Four of the seven technical sessions will be of the reporter-type, first tried in this country at the Combustion Conference at M.I.T., in 1955. European conferences have used it repeatedly for some time. The reporter will present a five or ten-minute synopsis of each paper which all present will have obtained when registering and have read beforehand. Several prepared written discussions will follow and oral discussion and author's response may then ensue.

Plant Trips

The plant trips include an inspection of an atomic submarine, a missile cruiser, and aircraft carrier at nearby Charlestown Navy Yard, on Tuesday afternoon, September 30, as well as a visit to the Boston Edison Company's Mystic Station, the Salem Harbor station of the New England Power Service Company, General Electric in Lynn, and Allis-Chalmers Manufacturing Company in Hyde Park, Mass.

Important Notice

ALL ASME members should note that the next issue of the ASME Membership List—AM 1 (alphabetical-geographical), to be published in January, 1959, will include information on record as of Sept. 30, 1958.

If there has been any change since Sept. 30, 1956, which you have not submitted to ASME Headquarters, please complete and return the form "Keep Your ASME Records Up to Date" on page 119 of this issue. For your convenience, this form appears in the ASME News Section of each issue of MECHANICAL ENGINEERING. It is important to you and the Society that the Master File information on our membership is up to date.

Appraisal of Export Coal Market to Keynote 21st ASME-AIME Solid Fuels Conference

Meeting to be held at Hotel Chamberlin, Old Point Comfort, Va., October 9–10

THE 21st annual solid fuels conference program of the Coal Division of the American Institute of Mining, Metallurgical, and Petroleum Engineers, and the Fuels Division of The American Society of Mechanical Engineers will be keynoted by the theme, "The Export Coal Market."

The conference will be held October 9 and 10 at the Hotel Chamberlin located on the tip of the historic Virginia Peninsula. This lovely resort spot is readily accessible by air, rail, and auto. An interesting trip, including Yorktown, Williamsburg, and Jamestown, is presently in the planning stage.

Waterside tours of the coal-loading facilities of several of the railroad companies in the area have been arranged.

E. E. Williams, vice-president, Duke Power Company, Charlotte, N. C., will preside at a luncheon featuring S. Pemberton Hutchinson, executive vice-president, General Coal Company, Philadelphia, Pa., as principal speaker. Mr. Hutchinson has chosen the conference theme as his topic—the export coal market.

A banquet is scheduled with ASME President James N. Landis presiding.

This event is highlighted each year by the presentation of the Percy Nichols Award, jointly sponsored by both societies and awarded for notable scientific or industrial achievement in the field of solid fuels. The major talk will be given at the banquet by C. S. Reid, Duke Power Company, whose topic is "Changing Times."

▶THURSDAY, OCTOBER 9

Session 1 — **10:00 a.m.**

Co-Chairmen: *H. Vaughn Mansfield*, Peabody Coal Co., Inc., St. Louis, Mo.
T. S. Spicer, Pennsylvania State College

Coal-Level Controls and Stoppage Alarms,[1] by *A. J. Stock*, Stock Equipment Co., Cleveland, Ohio

Design Considerations for Pneumatic Coal-Handling System,[1] by *Walter Gruca*, Standard Forgings Corp., Chicago, Ill.

Specific Problems Connected With Handling and Disposing of Combustion Refuse From Solid Fuels,[1] by *L. E. Mylting*, The Allen-Sherman-Hoff Co., Wynnewood, Pa.

Dock Handling of Bulk Materials,[1] by *R. C. Tench*, The Chesapeake and Ohio Railway Co., Richmond, Va.

Luncheon — **12:15 p.m.**

Presider: *E. E. Williams*, Duke Power Co., Charlotte, N. C.
Speaker: *S. Pemberton Hutchinson*, General Coal Co., Philadelphia, Pa.
Subject: **The Export Coal Market**

Inspection Trips — **2:00 p.m.**

Includes view of export coal facilities at Chesapeake and Ohio Railway Company Coal Piers, Norfolk and Western Railway Company Coal Piers, and Virginian Railway Company

Includes a waterside look at Newport News Shipbuilding & Dry Dock Co., Norfolk Naval Base, and Fort Monroe

▶FRIDAY, OCTOBER 10

Session 2 — **9:30 a.m.**

Co-Chairmen: *Carl S. Dennis*, The Chesapeake and Ohio Railway Co., Richmond, Va.
Herbert B. Lammers, Appalachian Coals, Inc., Cincinnati, O.

[1] Paper not available—see box on this page.

Equipment and Procedure for Carload Sampling,[1] by *A. Burr*, Cleveland Electric Illuminating Co., Cleveland, O., and *W. R. Reichenstein*, Fairfield Engineering Co., Marion, Ohio

Fundamental Studies in Bulk Solid Flow,[1] by *J. R. Lucas*, Ohio State University

Correlation of Free Swelling Index of Bituminous Coals With Other Standard Tests,[1] by *H. J. Rose*, Bituminous Coal Research Inc., Columbus, Ohio

Luncheon — **12:15 p.m.**

Presider: *George G. Ritchie*, AIME Conference Co-Chairman
Speaker: *Theodore Baumeister*, Columbia University

Session 3 — **2:00 p.m.**

Co-Chairmen: *Frank Feeley, Jr.*, Olin-Mathieson Chemical Corp., New York, N. Y.
Carroll F. Hardy, Bituminous Coal Institute, Washington, D. C.

First Cyclone-Furnace Fired Boiler in the Southeast,[1] by *W. L. Bross*, Greenwood Mills, Greenwood, S. C.

Start-Up and Operating Experiences With Coal and Delayed Coke-Fired Utility Boiler, by *S. C. Brown, Jr.*, Virginia Electric and Power Co., Yorktown, Va. (ASME Paper No. 58—FU-1)

Low Coke Button Bituminous Anthracite Equipment,[1] by *W. N. Sims*, American Cyanamid Co., New York, N. Y.

Banquet

Presider: *James N. Landis*, President, ASME
Speaker: *C. S. Reid*, Duke Power Co., Charlotte N. C.
Subject: **Changing Times**

Waterfront view of Hotel Chamberlin, Old Point Comfort, Va., where the 21st ASME-AIME Solid Fuels Conference will be held October 9 and 10

ASME Papers by Mail

ONLY *numbered* ASME papers in this program are available in separate copy form until Aug. 1, 1959. Copies can be obtained from the ASME Order Department, 29 West 39th Street, New York 18, N. Y. Prices are 25 cents each to members of ASME; 50 cents each to nonmembers. Papers must be ordered by the paper numbers listed in this program otherwise the order will be returned. The final listing of available technical papers will be found in the issue of MECHANICAL ENGINEERING containing an account of the Conference.

AIME Papers

AIME Joint Solid Fuels Conference papers submitted for publication will be considered for the Mining Transactions Section and the Features Section of *Mining Engineering* and as accepted will be published accordingly in *Mining Engineering*.

ASME-ASLE Lubrication Conference Offers Diversified Program

THE annual Lubrication Conference, cosponsored by the Lubrication Divisions of The American Society of Mechanical Engineers and the American Society of Lubrication Engineers, will be held for the first time on the West Coast. The 1958 joint meeting will be held at the Statler-Hilton Hotel in Los Angeles, Calif., October 13–15, with the local Sections of both societies acting as host to this lubrication forum that keeps growing in favor with the hundreds of engineers who attend the discussions each year.

Technical sessions are designed to include the discussion of many timely topics; for example, radiation resistance of lubricants, lubrication problems encountered in the aviation and missile-accessory fields, studies in friction and wear encompassing adhesion and sliding and special applications, fatigue created by rolling contacts. Also scheduled is an author-reporter session dealing with liquid and film bearings.

Many pleasant sight-seeing trips as well as pleasure trips are included on the program. High light of the event is the banquet which is to be followed by a dance this year.

▶MONDAY, OCTOBER 13

Session 1 **9:00 a.m.**

Radiation Resistance of Lubricants

Chairman: *M. Z. Fainman*, Inland Testing Laboratories, Morton Grove, Ill.

Vice Chairman: *R. B. Purdy*, Socony Mobil Oil Co., New York, N. Y.

Development of Radiation Resistance Oils, by *J. G. Carroll* and *R. O. Bolt*, California Research Corp. (ASLE Paper No. 58—LC-1)

The Effects of High-Energy Ionizing Radiation on Turbine-Oil Performance Characteristics, by *C. F. Kottcamp, R. P. Nejack*, Gulf Research and Development Co.; and *R. T. Kern*, Gulf Oil Corp. (ASLE Paper No. 58—LC-2)

Visco-Elastic Properties of Greases, by *E. O. Forster* and *J. J. Kolfenbach*, Esso Research and Engineering Co. (ASLE Paper No. 58—LC-3)

Session 2 **2:00 p.m.**

Gas and Liquid-Film Bearings (an author-reporter session)

Chairman: *Stanley Ausman*, Autonetics Div., North American Aviation Co., Dewey, Calif.

Vice-Chairman: *M. Wildman*, Autonetics Div., North American Aviation Co., Dewey, Calif.

An Analytical Study of the Effect of Offset Loads on the Performance of a 120-Deg Partial Journal Bearing, by *A. A. Raimondi*, Westinghouse Electric Corp. (ASLE Paper No. 58—LC-4)

Elastic and Damping Properties of Cylindrical Journal Bearings, by *B. Sternlicht*, General Electric Co. (ASME Paper No. 58—LUB-3)

Analysis and Characteristics of the Three-Lobe Bearing, by *Oscar Pinkus*, General Electric Co. (ASME Paper No. 58—LUB-2)

Axial Relative Motion of a Circular Step Bearing, by *Lasar Licht*, The Franklin Institute (ASME Paper No. 58—LUB-1)

Influence of the Molecular Mean Free Path on Performance of Hydrodynamic Gas Lubricated Bearings, by *A. Burgdorfer*, Shell Development Co. (ASME Paper No. 58—LUB-7)

Gas-Lubricated Sector Thrust Bearing, by *C. C. Mow* and *Edward Saibel*, Carnegie Institute of Technology (ASME Paper No. 58—LUB- 5)

▶TUESDAY, OCTOBER 14

Session 3 **9:00 a.m.**

Aircraft and Missile-Accessory Lubrication Problems

Chairman: *George Townsend*, Sunsfrand Turbo Denver, Colo.

Vice-Chairman: *R. L. Johnson*, Lewis Laboratories, Cleveland, Ohio

Development of Seals for Rocket-Engine Turbopumps, by *J. E. Wolf* and *R. E. Connelly*, Rocketdyne, Division of North American Aviation, Inc. (ASLE Paper No. 58—LC-5)

An Accessory Manufacturer's Approach to Bearing and Seal Development, by *S. Gray*, Stratos Division, Fairchild Airplane and Engine Corp. (ASME Paper)

A Study of Design Criteria for Oscillating Plain Bearings, by *W. A. Glaeser* and *C. M. Allen*, Battelle Memorial Institute (ASLE Paper No. 58—LC-6)

On Mechanism of Gear Lubrication, by *V. N. Borsoff*, Shell Oil Corp. (ASME Paper No. 58—LUB-4)

Session 4 **2:00 p.m.**

Wear I—Basic Studies in Friction and Wear (Adhesion and Sliding)

Chairman: *Adrian C. West*, California Research Corp., Richmond, Calif.

Vice-Chairman: *M. A. Wise*, General Petroleum Corp., Los Angeles, Calif.

Adhesion Between Metals and Its Effect on Fixed and Sliding Contacts, by *W. P. Mason*, Bell Telephone Co. (ASLE Paper No. 58—LC-7)

Transition Temperatures in Sliding Systems, by *R. S. Fein, C. N. Rowe*, and *K. L. Kreus*, The Texas Co. (ASLE Paper No. 58—LC-8)

Metallic Friction and Wear at Elevated Temperatures, by *E. P. Kingsbury* and *E. Rabinowicz*, Massachusetts Institute of Technology (ASME Paper No. 58—LUB-6)

An Investigation of Dry Adhesive Wear, Part 1, by *R. P. Steijn*, E. I. du Pont de Nemours & Co., Inc. (ASME Paper No. 58—LUB-8)

Wear and Metal Transfer Between Sliding Surfaces, Part 2, by *R. P. Steijn*, E. I du Pont de Nemours & Co., Inc. (ASME Paper No. 58—LUB-9)

Social Hour **6:30–7:30 p.m.**

Banquet With Dancing **7:30 p.m.**

▶WEDNESDAY, OCTOBER 15

Session 5 **9:00 a.m.**

Wear II—Basic Studies in Friction and Wear (Special Applications)

Chairman: *M. T. Antler*, Ethyl Corp., Detroit, Mich.

Vice-Chairman: *E. G. Jackson*, Small Aircraft Turbine Div., General Electric Co., West Lynn, Mass.

Wear and Friction of Filled Teflon Compositions in Liquid Nitrogen, by *D. W. Wisander, C. E. Maley*, and *R. L. Johnson*, NACA, Lewis Flight Propulsion Laboratory (ASLE Paper No. 58—LC-9)

The Conduction of Current in Bearings, by *H. N. Kaufman* and *J. Boyd*, Westinghouse Electric Corp. (ASLE Paper No. 58—LC-10)

A Surface Effect Associated With the Use of Zinc Dithiophosphate Treated Oils, by *P. A. Bennett*, General Motors Corp. (ASLE Paper No. 58—LC-11)

Film Formation by an Antiwear Additive in an Automotive Engine, by *M. J. Furey*, Esso Research and Engineering Co. (ASLE Paper No. 58—LC-12)

Session 6 **2:00 p.m.**

Rolling Contact Fatigue

Chairman: *A. S. Irwin*, Merlin Rockwell Corp., Jamestown, N. Y.

Vice-Chairman: *A. Hundere*, Alcor Inc., San Antonio, Texas

Operation of Ball Bearings Submerged in Liquefied Gases, by *K. B. Martin* and *R. B. Jacobs*, National Bureau of Standards (ASLE Paper No. 58—LC-13)

Effect of Fiber Orientation, Temperature, and Dry Powder Lubricants on Rolling Contact Fatigue, by *W. J. Anderson* and *T. L. Carter*, National Advisory Committee for Aeronautics (ASLE Paper No. 58—LC-14)

Rolling Contact Fatigue Evaluation of Bearing Materials and Lubricants, by *E. G. Jackson*, General Electric Co. (ASLE Paper No. 58—LC-15)

Materials in Rolling Contact Bearings for Normal and Elevated (45 F) Temperatures, by *T. W. Morrison, H. O. Walp*, and *R. P. Remprenko*, SKF Industries, Inc. (ASLE Paper No. 58—LC-16)

Women's Program

R. Sares, *Chairman*

▶Monday, October 13

All-Day Tour **8:30 a.m.**

All-day tour via Pico and Whittier to Disneyland; followed by lunch at Knotts' Berry Farm and tour of Knotts' Ghost Town and Arabian Horse Farm.

▶Tuesday, October 14

Half-Day Tour **8:30 a.m.–2:30 p.m.**

Half-day tour including Los Angeles Coliseum (home of the Los Angeles Dodgers), Hollywood Park, Exposition Park, Marineland via Palos Verdes Estates, drive along the Pacific Ocean Palisades.

Social Hour **6:30–7:30 p.m.**

Banquet and Dance **7:30 p.m.**

Registration

The Registration Desk in the Statler-Hilton Hotel will be open from 8:30 a.m. to 3:00 p.m. each day of the Conference, and on Sunday, October 12, from 3:30 to 7:30 p.m.

Papers by Mail . . . ASME

ONLY numbered ASME papers in this program are available in separate copy form until Sept. 1, 1959. Copies can be obtained from the ASME Order Department, 29 West 39th Street, New York 18, N. Y. Prices are 25 cents to members of ASME, 50 cents each to nonmembers. Papers must be ordered by the paper number listed in this program; otherwise the order will be returned. The final listing of available technical papers will be found in the issue of MECHANICAL ENGINEERING containing an account of the conference.

. . . ASLE

Copies of ASLE papers may be ordered by writing to ASLE, 84 East Randolph Street, Chicago, Ill. Papers are priced at 35 cents each to members and 50 cents each to nonmembers.

September 8–10

ASME Applied Mechanics Western Conference, University of California, Los Angeles, Calif.

September 21–24

ASME Petroleum Mechanical Engineering Conference, Cosmopolitan Hotel, Denver, Colo.

September 28–October 1

ASME-AIEE Power Conference, Statler-Hilton Hotel, Boston, Mass.

October 9–10

ASME-AIME Fuels Conference, Hotel Chamberlin, Old Point Comfort, Va.

October 13–15

ASME-ASLE Lubrication Conference, Statler-Hilton Hotel, Los Angeles, Calif.

November 30–December 5

ASME Annual Meeting, Statler-Hilton and Sheraton-McAlpin Hotels, New York, N. Y.

March 8–12, 1959

ASME Gas Turbine Power Conference and Exhibit, Netherlands-Hilton Hotel, Cincinnati, Ohio

March 8–12, 1959

ASME Aviation Conference, Statler-Hilton Hotel, Los Angeles, Calif.

March 29–April 1, 1959

ASME Instruments and Regulators Conference, Case Institute of Technology, Cleveland, Ohio

April 5–10, 1959

Nuclear Congress, Cleveland Auditorium, Cleveland, Ohio

April 13–15, 1959

ASME Hydraulics Conference, University of Michigan, Ann Arbor, Mich.

ASME COMING EVENTS

(*For Meetings of Other Societies, see page 103*)

April 19–23, 1959

ASME Oil and Gas Power Conference, Shamrock-Hilton Hotel, Houston, Texas

April 23–24, 1959

ASME Management-SAM Conference, Statler-Hilton Hotel, New York, N. Y.

Notice: Process Industries Conference Sept. 15-16, 1958, Buffalo, N. Y.

THE Buffalo Section of The American Society of Mechanical Engineers has announced that the Process Industries Conference, originally planned as a three-day divisional meeting, will be held over a two-day period, September 15 and 16, at the Hotel Statler-Hilton in Buffalo, N. Y.

As previously announced in the August issue of MECHANICAL ENGINEERING the technical program will be highlighted by two panel discussions on "Process Mixing" and "Value of Pilot Plants Maintained by Equipment Manufacturers."

Plant trips will be featured on the second day of the conference.

April 29–May 3, 1959

ASME Metals Engineering Conference, Sheraton-Ten Eyck Hotel, Albany, N. Y.

May 4–5, 1959

ASME Maintenance and Plant Engineering Conference, Edgewater Beach Hotel, Chicago, Ill.

May 12–14, 1959

ASME Production Engineering Conference, Statler-Hilton Hotel, Detroit, Mich.

May 25–28, 1959

ASME Design Engineering Conference, Convention Hall, Philadelphia, Pa.

June 14–18, 1959

ASME Semi-Annual Meeting, Chase-Park Plaza Hotel, St. Louis, Mo.

June 18–20, 1959

ASME Applied Mechanics Conference, Virginia Polytechnic Institute, Blacksburg, Va.

August 9–12, 1959

ASME-AIChE Heat-Transfer Conference, University of Connecticut, Storrs, Conn.

September 17–18, 1959

ASME-AIEE Engineering Management Conference, Statler-Hilton Hotel, Los Angeles, Calif.

September 20–23, 1959

ASME Petroleum Mechanical Engineering Conference, Rice Hotel, Houston, Texas

November 29–December 4, 1959

ASME Annual Meeting, Chalfonte-Haddon Hall, Atlantic City, N. J.

Note: Members wishing to prepare a paper for presentation at ASME national meetings or divisional conferences should secure a copy of Manual MS-4, "An ASME Paper," by writing to the ASME Order Department, 29 West 39th Street, New York 18, N. Y., for which there is no charge providing you state that you are a member of ASME.

Regional Administrative Committee Meetings in 1958

DURING March, April, and May of this year, the eight Regional Administrative Committees of The American Society of Mechanical Engineers met to discuss with the Vice-Presidents, various Regional and Society problems; to express Regional views on the National Agenda; and to provide representatives of Sections an opportunity to further the nominating procedure for national offices.

The Regional Administrative Committee Meetings were in session as follows: Region I, the University of Massachusetts, Amherst, Mass., May 9–10, 1958; Region II, Berkeley-Carteret, Asbury Park, N. J., April 28–29; Region III, Statler, Ithaca, N. Y., April 17–18; Region IV, Hermitage, Nashville, Tenn., April 12–13; Region V, Mountain View, Greensburg, Pa., April 21–22; Region VI, Continental, Indianapolis, Ind., April 25–26; Region VII, Kona Kai Club, San Diego, Calif., March 28–29; and Region VIII, Ridgewood, Beaumont, Texas, March 31–April 1.

The present RAC meetings procedures have evolved from long experience with various methods of bringing representatives of the Sections together. Delegates from Sections first met at the 1915 Spring Meeting in Buffalo, N. Y.—two representatives coming from each of the 15 Sections.

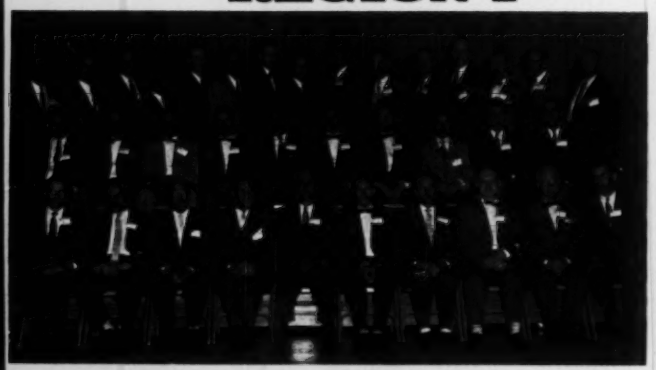
The Annual Conference started originally in 1916 and continued until 1951. The Sections had previously been grouped into seven groups for the purpose of selecting members of the Society Nominating Committee, and in 1932 the Annual Conference was replaced by seven-regional conferences using the same grouping used for Nominating Committee selection. A single delegate from each region attended a conference at the Annual Meeting. In 1935 the delegates from the regions were increased to two each, each serving overlapping terms of two years and the Annual Conference was moved to the Semi-Annual Meeting.

(*Continued on page 112*)

REGIONAL ADMINISTRATIVE

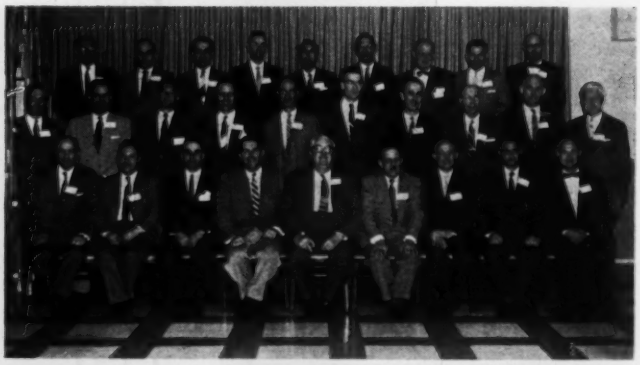
1 R. B. Dowdell, 2 W. P. Chaisson, 3 E. M. Barber, 4 O. B. Schier, II, 5 C. E. Crede, 6 F. M. Staszesky, 7 W. J. Govoni, 8 A. Hammer, 9 W. H. Weaver, 10 G. A. Marston, 11 R. B. Parker, 12 C. G. Parker, 13 F. S. Blackall, III, 14 E. W. Randall, 15 J. R. Canal, 16 K. E. Scott, 17 J. M. Bartlett, Jr., 18 R. D. Charette, 19 T. Chanoux, 20 W. P. Berggren, 21 J. J. Shanahan, 22 J. D. Melville, 23 J. H. Osgood, 24 A. H. Romboni, 25 A. S. Morton, 26 R. C. Hurd, 27 B. S. McCarroll, 28 B. F. Wickberg, 29 H. W. Carlson, 30 C. D. Lingenfelter, 31 H. J. McCabe, 32 H. M. Rogers, Jr., 33 P. W. Meyer, 34 C. S. White, 35 R. E. Roberts

REGION I



1 F. L. Bradley, 2 E. Miller, 3 E. D. Spina, 4 A. M. Perrin, 5 W. H. Byrne, 6 A. T. Kniffen, 7 W. Kopf, 8 R. Vitolo, 9 H. F. J. Sharbeck, 10 G. B. Thom, 11 W. Legier, 12 J. Seely, 13 M. Bishop, 14 W. Boswell, 15 C. W. Weiscopf, 16 D. B. MacDougall, 17 J. L. O'Neill, 18 G. T. Oergel, 19 V. W. Smith, 20 K. E. Quier, 21 S. C. Mitri, 22 R. J. Pecora, 23 R. B. Bryant, 24 H. H. Johnson, 25 J. de S. Coutinho, 26 W. S. Elliott, 27 P. T. Paraskevas, 28 W. B. Moen.

REGION II



REGION V

1 J. H. Wilder, 2 Ted Hendrickson, 3 W. C. Bissmeyer, 4 D. F. Quan, 5 Joe Miller, 6 D. G. Jones, 7 C. R. Leonard, 8 J. A. Brown, 9 E. W. Miller, 10 R. V. Reynolds, 11 Ray Hollaway, 12 O. B. Schier, II, 13 E. W. Allardt, 14 C. E. Youngblood, 15 Dwight Craig, 16 A. L. Clark, 17 Eugene Linkser, 18 E. P. Schrank, 19 John Uicker, 20 Fred Sutter, 21 Walton Forstall, 22 B. F. King, 23 George Shimp, 24 Dick Austin, 25 Roland Crans, 26 G. E. Pankratz, 27 G. J. Hanks, Jr., 28 R. F. Cornish, 29 C. E. Jones, 30 C. P. Welch, 31 Dave Carr, 32 Art Heiberg, 33 Robert Nelsen, 34 J. R. Lowe, Jr., 35 M. D. Gunselman, 36 Arnold Hoffer, 37 J. T. Davey, 38 E. S. Howarth, 39 Bruce Adams, 40 Harold Cather.

REGION VI

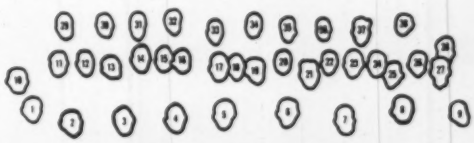
1 H. H. Mohl, 2 C. R. Stahler, 3 J. R. Buss, 4 Gus Sample, 5 George Germain, 6 R. S. Perry, 7 C. F. Harrod, 8 J. A. Albert, 9 R. W. Smith, 10 L. E. Myers, 11 Lowell Tainter, 12 H. E. Campbell, 13 Maurice Olchoff, 14 D. R. McLeish, 15 Walter Kilgard, 16 E. LaCrosse, Jr., 17 F. P. Vanella, 18 M. E. Timmcke, 19 M. E. Jansen, 20 J. L. Wilkins, 21 R. H. Myers, 22 E. W. Jerger, 23 H. A. Jespersen, 24 C. A. Davis, 25 Robert Meyer, 26 R. D. Teece, 27 Bert Getsug, 28 N. H. Barnard, 29 J. E. Rudolph, 30 L. F. Peckman, 31 Dimitri Kececioglu, 32 E. B. Penrod, 33 H. Schauberger, Jr., 34 R. J. Sullivan, 35 Francis Seyfarth, 36 D. L. Olberts, 37 E. R. Stensass, 38 F. E. Wittig, 39 R. S. Stover, 40 R. W. Mills, 41 O. B. Schier, II, 42 H. B. Ratcliff, 43 Don Blue.

COMMITTEE MEETINGS

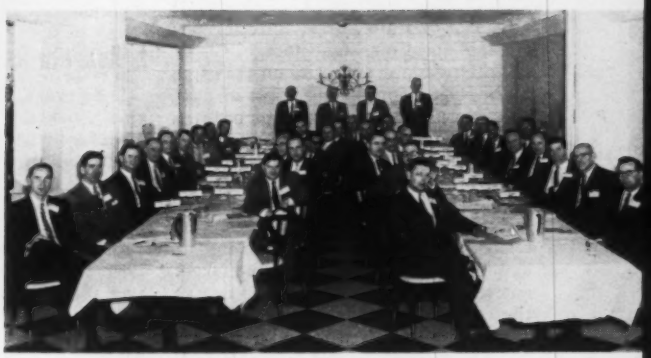
1 R. W. Miller, 2 C. Concordia, 3 C. L. Wilder, 4 L. Conta, 5 F. F. Tone, 6 H. O. Huss, 7 R. H. Swoyer, 8 J. R. Chowning, 9 R. E. Roushey, 10 W. G. McLean, 11 J. C. Dykman, 12 G. R. Leavitt, 13 W. E. Belcher, Jr., 14 D. E. Marlowe, 15 A. W. Weber, 16 R. K. Persin, 17 J. E. Corr, 18 F. J. Heinze, 19 K G. Dorwart, 20 M. B. Hogan, 21 J. E. Thompson, 22 I. Katz, 23 R. Plunkett, 24 M. B. Moyer, 25 F. J. Jeffers, 26 O. B. Schier, II, 27 H. A. Naylor, Jr., 28 L. K. Kirchmayer, 29 R. W. Smith, 30 W. E. Cooper, 31 E. L. Anderson, 32 T. W. Hopper, 33 G. L. Graves, 34 D. Fairchild, 35 T. W. Fitzgerald, 36 R. E. Derby, 37 R. M. Phelan, 38 E. L. Paulsen, 39 T. Howitt, 40 C. F. Moore.

REGION III

1 K. R. Daniel, 2 J. B. Jones, 3 E. E. Burroughs, 4 A. R. Johnson, Jr., 5 W. L. Moss, 6 A. B. Purdy, 7 L. L. Johnston, 8 L. M. Parker, 9 H. S. Weber, 10 S. D. Moxley, 11 E. E. Williams, 12 J. H. Sams, 13 N. W. Conner, 14 M. E. Kirkpatrick, 15 A. C. Thies, 16 Harold Couch, 17 K. T. Knight, 18 J. K. Whitfield, 19 M. I. Lundin, 20 F. R. O'Brien, 21 T. O. Ott, Jr., 22 H. E. Kloepfer, 23 J. B. Lasley, 24 C. C. Eich, 25 H. S. Miles, 26 J. C. Reed, 27 W. A. Snellgrove, 28 John Little, 29 O. B. Schier, II, 30 T. C. Heyward, Jr., 31 R. E. Rabun, 32 G. B. DeHoff, 33 C. S. Dennis, 34 A. H. Hines, Jr., 35 G. W. Marshall, 36 M. C. Pannell, 37 H. E. Keunzel, 38 E. M. Ketchie.



REGION IV



REGION VII

1 V. A. Peterson, 2 S. H. Graf, 3 C. F. Nichols, 4 F. R. Montgomery, 5 H. S. Aurand, 6 O. B. Schier, II, 7 L. C. Koke, 8 J. W. MacPherson, 9 B. T. McMinn, 10 F. W. Beichley, 11 R. H. Meleney, 12 E. M. Johnston, 13 L. R. Gensman, 14 R. F. Steidel, 15 R. C. Portouw, 16 R. A. Bowman, 17 R. S. Peterson, 18 R. D. Spear, 19 L. M. Finch, 20 W. B. Nordquist, 21 C. Morgan, 22 W. Wallace, 23 A. H. Scott, 24 J. E. Holcomb, 25 G. E. Hallen, 26 J. M. Simonsen, 27 D. King, 28 D. Price, 29 H. O. Fuchs, 30 F. Greaves, 31 J. W. Wasson, 32 J. P. Hardway, 33 H. A. Simms, 34 R. M. Kuhns, 35 A. G. Long.

REGION VIII

1 Harold Grasse, 2 C. H. Shumaker, 3 O. B. Schier, II, 4 R. B. Kinzback, 5 A. L. Decker, 6 A. R. Garling, 7 P. K. Harris, 8 A. A. Rasmussen, 9 B. P. Robertson, 10 B. E. Arthur, 11 M. A. Smith, 12 J. W. McKiernan, 13 W. J. Graff, 14 L. B. Sharpsteen, 15 J. W. Zilboorg, 16 H. H. Urech, 17 A. R. Mozisek, 18 A. Rodreguez, 19 P. P. Schwartz, 20 W. C. Millis, 21 R. Benninghoven, 22 B. G. Barr, 23 E. A. Lyle, 24 A. W. Betz, 25 J. Parmakian, 26 H. A. Thurstin, 27 S. F. Montroy, 28 W. J. Verlander, 29 D. C. Smith, 30 H. McPherson, 31 J. F. Vogt, Jr., 32 S. Ellis, Jr., 33 W. H. Parks, 34 E. Beason, 35 W. R. Clarke, 36 T. H. Power, 37 G. J. Groh.

RAC *(Continued from page 109)*

In 1940, the number of regions was increased to eight. The following year the Vice-Presidents were assigned regional responsibilities and the present Regional Administrative Committees came into being made up of two representatives of each Section. At the same time the Regional Delegates Conference was formalized.

The RAC meetings are held each year during March, April, or May. The place is decided at the preceding RAC meeting or by the Vice-President. The date is arranged among the Vice-Presidents, the Host Section, and the Secretary's office, and confirmed at a meeting of Vice-Presidents.

A report on the 1958 Regional Delegates Conference, held during the ASME Semi-Annual Meeting in Detroit, Mich., June 15–19, at the Hotel Statler, will appear in a forthcoming issue of MECHANICAL ENGINEERING.

ASME Elects Nine to Grade of Fellow Member

THE American Society of Mechanical Engineers has honored nine of its members by electing them to the grade of Fellow of the Society.

To be qualified as a nominee to the grade of Fellow, one must be an engineer with acknowledged engineering attainment, have 25 years of active practice in the profession of engineering or teaching of engineering in a school of accepted standing, and be a member of the Society for 13 years. Promotion to the grade of Fellow is made only on nomination by five Fellows or members of the Society to the Council, to be approved by Council.

The men who were so honored for their outstanding contributions to their profession and to the Society are:

Jerome J. Kanter

JEROME JULIUS KANTER, directing engineer, Crane Company, Chicago, Ill., is an acknowledged authority on the effect of temperature on the properties of metals. He joined the Crane Company in 1920 as a testing engineer and has been assistant chief chemist and metallurgist; materials research engineer, and in 1947 assumed his current position. Among the early investigators in the field of elevated temperatures, he was responsible for the development of creep testing equipment and techniques. He was the recipient of the 1929 ASTM Dudley Medal Award in recognition of this work with the late L. W. Spring. Seizure tendencies of metals under load, usually in the absence of lubrication, have been the object of Mr. Kanter's study for many years. He is coinventor of a machine for evaluating these characteristics and was instrumental in development of a more advanced type of machine for this work. Failure of a main steam line due to graphite formation in an area adjacent to a welded joint posed a serious metallurgical problem in the steam-power industry. Mr. Kanter participated in co-operative studies of this phenomenon and was chairman of the project on this problem undertaken by the Joint ASTM-ASME High Temperature Committee. His developments extend over a number of interests. This is demonstrated by several of the patents issued to him; namely, for a variable velocity impact testing machine for a heat-treating process for creep resisting bolting steel and for anticipatory thermocouples. Mr. Kanter has been author or coauthor of over 60 articles and papers in journals of professional societies and in the technical press. His activities on behalf of professional societies have been extensive. He has participated widely in the committee activities of ASTM, ASME, MSS, and ASA. He is a member also of AIME, ASM, and AFS. In 1952 he was among the recipients of the ASME Award of Merit in recognition of his "consistent and constructive work in standards and research over many years." At the recent ASTM Annual Meeting he was made Chairman of Committee A-1 on Steel.

J. Kenneth Salisbury

J. KENNETH SALISBURY, consulting engineer, Atherton, Calif., has been recognized for his achievements in the field of steam and gas turbine power plants and thermal power systems. The career which has distinguished him began with the General Electric Company with which he was associated from 1930 to 1953. He resigned his position as manager of the Thermal Power Systems Division to accept a professorship of mechanical engineering at Stanford University. While at Stanford he was also manager of the Heat and Mechanics Section of Stanford Research Institute, as well as a consultant to the Institute. In 1956 he established his own consulting practice, with offices in Atherton. A partial list of his clients includes: U. S. Navy Bureau of Ships, Ramo-Wooldridge Corporation, Bailey Meter Company, Duke Power Company, and Aerojet-General Corporation. Mr. Salisbury's writings include many ASME papers and discussions in the technical press; two books "Steam Turbines and Their Cycles" and "Heat Engineering and Thermodynamics"; contributions to the "Encyclopedia Britannica," "Collier's Yearbook"; and others. He is editor-in-chief of the Power volume of "Kent's Mechanical Engineers' Handbook," Twelfth Edition.

In 1942, ASME presented the Melville Medal Award to him for his paper "The Steam-Turbine Regenerative Cycle—An Analytical Approach." In 1951 the Society selected him as the recipient of the Pi Tau Sigma Richards Memorial Award for outstanding achievement in mechanical engineering within 20 to 25 years after graduation. He was cited as a Distinguished Alumnus by the University of Michigan in 1953. In 1947 he was awarded the Honor Scroll by the ASME Oil and Gas Power Division for his paper, "The Basic Gas Turbine Plant and Some of Its Variants." He has served the Society in a great many capacities, notably as a charter member of the Gas Turbine Power Division, its chairman in 1949; a member of its Executive Committee from 1948 to 1951; and an Associate from 1952 to date. He has been chairman of the Schenectady Section and was a member of the following ASME committees: Publications, Lecturers, and Medals. Mr. Salisbury is a member of Pi Tau Sigma, Sigma Xi, Iota Alpha, and Phi Kappa Phi.

Myron A. Kendall

MYRON AVERY KENDALL, chairman of the board, Stephens-Adamson Manufacturing Company, Aurora, Ill., is recognized as a leading conveyer engineer. His career with Stephens-Adamson began in 1907 as a draftsman. He went on through steps as chief draftsman, general superintendent, and chief engineer and director to assume his present office. In that career which spanned over 50 years, he has to his credit a number of firsts. He was the designer of the first successful long-distance belt conveyer—a four-and-one-half-mile conveyer system on the banks of the Monongahela River, W. Va.—35 years ago. He perfected the first successful antifriction bearing carrier, coupled with other conveyer features which made possible long-distance conveying. Other milestones in his career are the development of a full turnover pivoted bucket carrier; the live-shaft

three-pulley carrier; the self-unloading bulk-cargo vessel; and the Carveyor, Speedwalk, and Speedramp Passenger Conveyer Systems. Mr. Kendall's early design for a self-unloading bulk cargo vessel was adopted by the *SS Wyandotte*, *SS Alpena*, *SS Calcite*, *SS West*, and others. Presently, he is the chairman of the Lake Terminal Committee for the River Lake Belt Conveyer Lines, a committee set up to design the first overland belt-conveyer system for long-distance transportation of bulk materials. He has been a leader in many civic endeavors; has been a member of the West Aurora Board of Education, the Area Council of the Boy Scouts of America, and many other groups. He is a member of Tau Beta Pi.

Harold E. Martin

HAROLD EDWARD MARTIN, chief executive officer and president, Metal & Thermit Corporation, New York, N. Y., has earned recognition for a career which coupled engineering with management activities. Development work in refractories and original design work on refractory and insulating material for furnaces, ovens, and paper-machine hoods claimed his attention as a young engineer with the Johns Manville Corporation, from 1921 to 1929. At the end of this period he joined The Babcock & Wilcox Company where he acted as sales engineer, district manager of their Cincinnati Office (Fuller Lehigh Company), and sales engineer on large utility accounts in New York. In 1942, as district manager of the New York office, he held responsibility for sales, service, and erection in the metropolitan area and adjacent states. His administrative tasks involved considerable planning of organization systems and methods which were used as a pattern in planning other districts of The Babcock & Wilcox Company. During World War II, he organized a group, independent within the company, to design, fabricate, and erect 43 mobile power plants abroad. Completion of the contract on time and in line with estimates represented an unusual management achievement. From 1947 to 1952, Mr. Martin assumed the responsibility for all of the company's foreign sales, service, and installation, as director of export. As president and member of the board of directors, he joined the Metal & Thermit Corporation in 1954. In this position he has led the company through a complete reorganization of staff, policies, and general outlook toward its future growth. He is an officer or director of a large group of companies a partial list of which include: Chromium Corporation of America, International Titanium Corporation, Tin and Chemical Corporation, and Polytechnic Research and Development Company. His activities on behalf of the Society have been numerous and include membership on the Executive Committee of the Metropolitan Section, 1942 to 1945; Director-at Large, 1950 to 1954; and member of the Executive Committee of Council, 1953 and 1954. Mr. Martin also has contributed considerably as a civic leader. He is a member of Tau Beta Pi.

Harold B. Maynard

HAROLD BRIGHT MAYNARD, founder of Methods Engineering Council, Pittsburgh, Pa., is well known to industry as a consultant in industrial management. His first years in industry were spent with the Westinghouse Electric Corporation. At the time of his resignation from that company, he was superintendent of production of the Steam Division, South Philadelphia, Pa. After a period of consulting work and subsequent preparation, he organized the Methods Engineering Council in 1934. The Council maintains an outstanding world-wide position in the field of industrial-engineering consulting, particularly as related to time-and-motion study, job evaluation, plant layout, and wage-incentive plans. In 1957 the Council acquired the management-consulting firm of Bigelow, Kent, Willard & Company and the over-all name of the company was changed to H. B. Maynard and Company, Inc.; Mr. Maynard is president. Mr. Maynard is one of the originators of Methods-Time Measurement, MTM, a technique used to set work and production standards based upon predetermined time units for manual motion. He has written extensively on management practice for the technical press and society papers and is the author of many widely used technical books and courses. He is currently editor-in-chief of the "Industrial Engineering Handbook," published by McGraw-Hill Publishing Company. The Society has twice previously honored him; in 1948, when he was named the Towne Lecturer and, in 1949, when he received the Melville Prize for a paper on the role of scientific management in world recovery. In 1946, the Society for the Advancement of Management presented the Gilbreth Medal to Mr. Maynard. He is the recipient also of the 1956 Wallace Clark Award for his "distinguished contribution to scientific management in the international field." He has been a member of the ASME Management Division's General Management Committee, the Committee on Standardization of Process Chart Symbols and Therbligs, and the Work Standardization Committee. He has been a national president of such groups as the Society for the Advancement of Management, the MTM Association for Standards and Research, and the Council for International Progress in Management. For four years he was deputy president of CIOS, the International Committee of Scientific Management with headquarters in Geneva, Switzerland, and was president for two years.

Arthur H. Morey

ARTHUR HERBERT MOREY, manager of Railroad Locomotive Advance Engineering, General Electric Company, Erie, Pa., has had an outstanding career devoted to design, building, and testing of all components of both steam and gas turbine electric locomotives. His career with General Electric began in 1930 as a design engineer. In 1946, he became project engineer responsible for the direction and co-ordination of gas turbine electric locomotive development. As section engineer from 1953 to 1954, he was responsible for the direction and coordination of building and testing of 15 gas turbine electric locomotives. At the end of this period he became supervisor of engineering responsible for correction of difficulties on 25 gas turbine locomotives and for the design of new 8500-hp locomotives. These locomotives differed radically from those sold previously. They were the largest internal-power locomotives to be built, and presented many new and unusual problems in design. In 1957 he became manager of Railroad Locomotive Advance Engineering, General Electric Company. Mr. Morey holds many patents relating to locomotive designs and is the author of numerous papers presented before professional societies and published in the technical press.

Gordon R. Milne

GORDON ROSS MILNE, chief mechanical engineer, Consolidated Edison Company of New York, has throughout his career of almost 40 years been concerned with the generation and distribution of steam and electricity, an area in which he is a specialist. His career was launched at Thomas Alva Edison Industries, Inc., West Orange, N. J. In 1921 he joined United Electric Light and Power Company and, through mergers in 1935 and 1936, became associated with The New York Edison Company, Inc., and The Consolidated Edison Company of New York, Inc. Since 1952 he has been studying the commercial application of nuclear

energy for electric power generation through association with the Dow Detroit Edison study group, now the Atomic Power Development Associates. When Consolidated Edison decided to investigate the possibility of building a nuclear plant, he had a major part in the selection of the reactor system and in the subsequent license application now pending before the AEC. The design of the conventional part of the plant and the design co-ordination with the nuclear generator will be under Mr. Milne's direction. He is the author or coauthor of a number of papers published in technical journals and presented at technical meetings. He has served the Society as a member of Research Committees on Furnace Performance Factors, Low Temperature Flue Gas Corrosion and Fouling, the committee on Air Pollution Controls, subcommittee on Power Boilers of the Boiler Code Committee. He is a Fellow of the American Institute of Electrical Engineers and a member of the Air Pollution Control Association.

George M. Muschamp

GEORGE MORRIS MUSCHAMP, vice-president in charge of engineering, patent-attorney, and patent engineer, Brown Instruments Division, Minneapolis-Honeywell Regulator Company, Philadelphia, Pa., headed the team of Mechanical and Electrical Engineers which in 1940 completed a development which revolutionized industrial instrumentation. These instruments embodied the principles, now standard for most industrial potentiometers in use in this country, which permitted the manufacture of an accurate, reliable, and inexpensive device with fewer moving parts, lighter assemblies, and faster response. This resulted in the gradual abandonment of mechanical potentiometer designs and the constant improvement of the electronic concept. He joined the Brown Instruments Division in 1930. In the period since 1939 he has managed with growing competence an engineering department which then numbered 75 and now totals 500. He has just been promoted to vice-president—engineering, Industrial Products Group of Honeywell which includes in addition to the Brown Instrument Division, the Valve and Rubicon Divisions in Philadelphia; the Missile Division, Pottstown, Pa.; the Davies Division, Beltsville, Md.; Heiland Division, Denver, Colo.; and the Fall River Division. He is a registered professional engineer in the State of Pennsylvania and has been a registered patent attorney since 1934. Mr. Muschamp is the attorney of record for over 150 patents. His list of papers on automatic instrumentation, patents, and the engineering profession is extensive. The Society received his services in a great many activities. Currently, he is chairman of a Subcommittee to Review the Constitution and By-Laws. He was chairman of the Constitution and By-Laws Committee, the Organization Committee, the Philadelphia Section, and a member of the National Nominating Committee. He served as the Philadelphia delegate to the Engineering Manpower Commission and United States Representative to the International Nuclear Standards Conference in Geneva; is a member of The Franklin Institute and its Committee on Science and the Arts. An alumnus of the Drexel Institute of Technology, in 1951 he received the Drexel Institute Citation. He is a member of many societies among which are the Newcomen Society in North America, the American Ordnance Association, the Scientific Apparatus Maker's Association, the Instrument Society of America, and the Society for the Advancement of Management. He has been active in community and charitable affairs; is a member of numerous cultural societies including the Germantown Historical Society, the Society of Antiquaries of Newcastle-Upon-Tyne, and the English Speaking Union. His clubs are Philadelphia Cricket, Germantown Cricket, Engineers, and Spray Beach Yacht.

Albert C. Pasini

ALBERT CARL PASINI is assistant general superintendent of production, Detroit Edison Company, Detroit, Mich. In his 35-year association with that company, he has supervised many projects concerned with the design, operation, maintenance, and management of steam-electric power-generating facilities in some of the world's largest utility plants. Currently, he is project director for the thermo-electric-generating portion of the Enrico Fermi Atomic Power Plant. His professional record is impressive; in addition, he has contributed greatly to the development of young engineers and the general growth of his profession. Mr. Pasini has served in the Engineering Society of Detroit. He has also served on several subcommittees of the Edison Electric Institute. During World War II he was fuel engineer on the fuel-efficiency council in the Solid Fuels Adminis-

Call for Agenda Items for 1959 RAC Meetings

THE 1959 Agenda Committee extends an invitation to every member of ASME to offer suggestions and improvements in the operations of the Society. This invitation is a step in the democratic process by which the membership and the Sections impart their ideas to the Council.

Please word your proposed items so that they are clear and specific and so that there will be no misunderstanding as to intent. Also, be sure the wording is positive so that action can be taken either to "approve" or "reject" the item as worded. Accompany each item with a short statement as to why you feel the item should be approved.

All agenda items are to be submitted in accordance with the following form, *and should be sent to the Secretary of your Section not later than October 1, 1958*. The Agenda Committee of each Section will screen these items against items previously considered by the Council, and forward the items to the National Agenda Committee not later than November 3, 1958.

If you lack the address of your Section Secretary, you may send your items, *not later than October 1, to the ASME Agenda Committee, 29 West 39th Street, New York 18, N. Y.*

ASME Agenda Item

PROPOSED BY..... of the.....Section

Address.....

Date..... .....

Signature

Item: It is proposed that (*Proposer's Comment:*)

tration. His participation in ASME activities has been extensive. On the local level, he has been chairman, secretary, treasurer, and Program Committee chairman of the Detroit Section. He served as Vice-President, Region V, 1949–1951, 1955–1957; and was a director-at-large, 1951–1955. He has been chairman of the following groups: National Agenda Committee, National Membership Development Committee, and Board on Technology. He helped to organize the Nuclear Engineering Division and was its first chairman, and now serves as adviser to the Division. Mr. Pasini is the author of several papers which have been published in the *Transactions of the ASME*. He has also published articles in various technical journals. He holds membership in Theta Chi Fraternity, Pi Tau Sigma, and Tau Beta Pi. He is also a member of the Society of American Military Engineers, American Ordnance Association, National Society of Professional Engineers, and a registered professional engineer in the State of Michigan.

Conducted for the National Junior Committee

N. J. VIEHMANN[1]

JUNIOR FORUM

National Junior Committee Annual Report, 1957-1958

THE National Junior Committee has continued during the year 1957-1958 to carry out its work as defined in the Constitution and By-Laws of the Society. The Committee has commenced to reduce to writing its history, functions, operations, and purposes to aid in (1) determining its future actions, (2) increasing continuity, and (3) being more effective.

The Committee also attempted to make the ASME more real and vivid to the Student Sections throughout the country. It has actively attacked the problem of professional and Society development among young engineers, and has secured a representation more truly national in character.

Student-Society Bridge

In order to make the ASME more effective at the student level, the National Junior Committee has continued its industrial-indoctrination program. The Committee has received reports from various Regions indicating success in these programs, with the intent to adopt the basic program as a part of their scheduled local affairs.

Along these same lines the Committee is in the process of reviewing the Engineering Society of Cincinnati Vocational Guidance Program in an effort to determine how this program could be utilized to its greatest degree. The general objectives of the Vocational Guidance Program is to acquaint high-school students with the various fields of engineering, assisting them in determining whether their potentials are such as to indicate that engineering is the best vocation for them, and to guide them in the proper curriculum preparatory to a college engineering course. Although this program only started in Cincinnati in 1953 with an attendance of 200 students, the students' interest was stimulated to the extent that the average attendance for the past four years has exceeded 700 students.

A step has been taken to procure better integration with the Engineers' Council for Professional Development. The Chairman and/or the Senior Adviser of the National Junior Committee will be included as a regular member of the ECPD Training Committee.

For the young engineers after graduation, the National Junior Committee has been conducting a series of panel discussions throughout the country on the theme, "The Young Engineer and His Future." In addition, articles have been published in MECHANICAL ENGINEERING.

Junior Forum

The Junior Forum has tried to direct the attention of its readers to three aspects of an engineering career which are vital to the young engineer who is seeking to improve himself:

1 How the young engineer can plan for his professional development.

2 What is the nature of the assignments handled by young engineers in related fields, and how do they progress?

3 What are other engineers thinking, and what are they doing about their own professional development?

A series of articles that ran from last November through March of this year hammered at the first aspect. April's article was one of a continuing series on various engineering jobs. The May article gave the young engineer who aspires to management something authoritative to ponder. The third aspect was touched upon in the three summer articles. The Forum will continue to attempt to present a fare which is of vital interest to the young engineer.

Junior Forum also has included as a regular feature the "Chairman's Corner" in an effort to "get closer" to the young members of the Society.

Increase the Scope

The National Junior Committee has tried to increase further the scope of its representation in order to be more truly national in nature. As a result,

Chairman's Corner

Now that the technical season is reactivated after the summer vacation, it is hoped that you, the young Associate Member, will take an even more active part in Society affairs. The Student members of last season who have or are contemplating transferring to Associate grade, should notify the Section in their area and get "on board." Do not find yourself missing the opportunities and benefits of Society membership and active participation by hesitation.

W. V. Chambers, Chairman,
National Junior Committee,
General Electric Company,
Cincinnati, Ohio

[1] Product Planning Engineer, Western Electric Company, North Andover, Mass. Assoc. Mem. ASME.

it has solicited the South, Southwest, and Western Regions of the country for young men to become active on the Committee. Efforts are being made also to establish closer liaison with the Section junior activities throughout the country. Along these lines the Committee co-ordinated the experience of the Chicago and Cincinnati Section Junior Committees in helping to establish a Region V Young Associate Committee. This Region V Young Associate Committee came into existence officially at the Spring Meeting in Detroit, Mich.

The Committee has continued in its effort to write the National Junior Committee history and Manual of all the unwritten policies, procedures, and duties necessary to be effective.

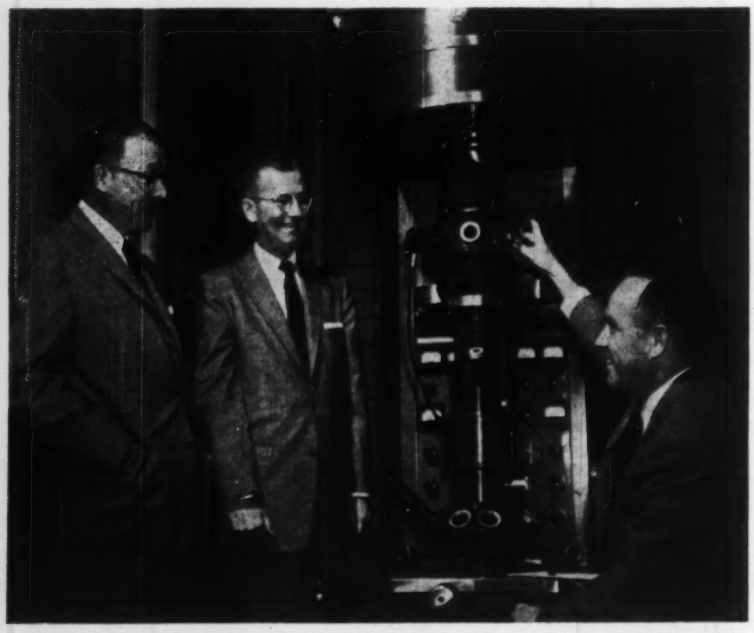
During the coming year, 1958-1959, the National Junior Committee will continue to work with the young engineer and his development. The theme for next years's activities will be the same as last year's, "The Young Engineer and His Future."

W. V. Chambers, *Chairman*,
National Junior Committee.

EDUCATION

New Courses

● THE Metals Engineering Institute, a division of the American Society for Metals, announces that the first in a series of 39 home-study and in-plant training courses is now available to both individuals and industry. "Elements of Metallurgy" begins with a study of the structure and properties of metals, discusses chemical reactions of metals, and pays special attention to smelting, refractories, refining, and electrolytic processes. Physical aspects of solidification, heat-treatment, precipitation hardening, diffusion and surface treatments, and methods of testing round out this broad, basic, up-to-the-minute course—of interest to individuals and technical and administrative personnel. An instructor assigned to each individual, corrects papers, makes helpful comments, and forwards lessons according to a schedule set by the student himself. MEI guidance and special instructional assistance is also available to industrial groups who wish to use the course as an in-plant or on-the-job training program. Framed certificates are awarded to those who successfully complete the 15-lesson course.



Maurice Morton, *right,* director of the University of Akron Institute of Rubber Research, explains details of department plans for the electron microscope presented to the Institute by the Goodyear Tire & Rubber Company, Akron, Ohio. His audience, *left to right:* R. P. Dinsmore, vice-president, Goodyear research and development, and University President Norman P. Auburn.

Endowments

● NEAR the end of the first year of The Cooper Union's three-year Centennial Development Fund drive, the school has received three gifts totaling $350,000. Miss Doris Duke has made a gift of $100,000 for the advancement of science and art in memory of her father, the late James B. Duke. The Charles Hayden Foundation has presented $150,000, and the James Foundation of New York, Inc., has contributed $100,000. These donations are to be applied to the cost of the proposed new building for The Cooper Union School of Engineering. Construction of a new engineering building is included in The Cooper Union's Centennial Development Program, which also includes enlarged quarters for the Cooper Union Art School, increased endowment for faculty salaries, and other educational improvements.

● GRANTS totaling over $1 million have been awarded to 135 universities and colleges in Du Pont's annual program of aid to education. The total for the next academic year is about $100,000 more than Du Pont contributed for this school year. Most of the increase and more than half of the entire program are grants to colleges and universities for strengthening the education of scientists and engineers. These grants will support the teaching of science and mathematics as well as other subjects. At the same time, grants for fundamental research are being continued, as are grants for fellowships, which once made up the entire plan. As in previous years, decisions on the use of the funds and the selection of people to receive individual grants are left to the institutions.

On-the-Job Study

● A PARTIAL answer to the nationwide shortage of engineers has been furnished by the General Electric Company at the Hanford atomic plant which the company operates for the Atomic Energy Commission.

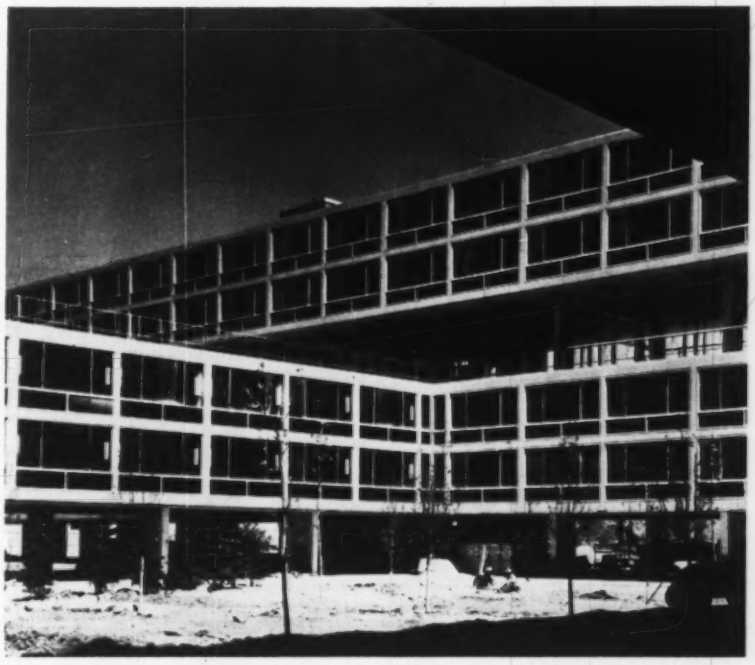
At the Hanford plant, General Electric is training men and some of its women employees to become engineers while they remain on the job. Working as engineering assistants, those learning to be engineers can take much of the load off scientists and engineers who earlier were swamped with excessive detail.

To help in training new engineers and scientists, General Electric has set up at Hanford a unique school of nuclear engineering where subjects are studied which a few years ago were problems without solutions. Although this school is only 10 years old, it already has taken its place as a veteran in the atomic-educational field and as a producer of leaders in peacetime and defense atomic-energy development. The Hanford nuclear school grants no degrees of its own, but has a working arrangement with four northwest colleges and universities accrediting courses there toward undergraduate and graduate degrees.

● A FOUR-YEAR apprenticeship training program for tool and gage inspectors for The Timken Roller Bearing Company's tool and gage laboratory has proved to be an excellent way of providing the men with high degree of skill and knowledge needed for this work. This laboratory is the keystone of the tool inspection department which has complete responsibility for the inventory and accuracy of over half a million tools, reference gages, and working gages used in all of the company's plants. High-school graduates are selected for their ability in mathematics, for their above average grades, and for their good personality. Personality is important. As tool inspectors they will be inspecting close tolerance work and may have to reject a part that an experienced machinist has worked on for many hours. Also, a high percentage of these inspectors is expected to advance to more important jobs of supervision and engineering as well as for special assignments. To date 50 per cent of trained tool and gage inspectors have been so promoted.

Applicants are interviewed and given tests to determine their chance of succeeding in the training program. The top applicants are selected for the tool and gage inspection work.

● TEMCO Aircraft Corporation, Dallas, Texas, in an effort to help prepare high-school students for careers in science and engineering, is providing four of its best-qualified engineers to teach physics courses in four local high schools on a part-time basis. The plan was adopted when it was learned that these schools did not offer physics courses because qualified teachers were not available. Students at the schools enthusiastically received the program and are currently receiving the physics training that will prepare them for college engineering training or further technical education.



View of inner courtyard of Cadet Quarters Building gives some idea of the huge aluminum extrusions used for horizontal beam covers on new Air Force Academy, Colorado Springs, Colo. The extrusions, largest ever made for architectural use, were fabricated by Aluminum Company of America at Lafayette, Ind. The project will set a new record for the use of aluminum, with more than 5-million lb used throughout the AF Academy.

Trends

● THE Engineering Institute of Canada has released the results of its annual survey of engineering registration at Canadian universities and colleges. The tabulations have been prepared from lists obtained directly from the university registrars, and they were compiled at Institute Headquarters in Montreal.

Total enrollment in engineering courses in Canada shows an increase of 12 per cent, which is almost exactly the same rate of advance as one year ago. In actual numbers, 14,247 students are now studying engineering, as compared with 12,723 in the fall of 1956.

Of more importance perhaps are the indications provided by the figures for the new freshman intake. These show an encouraging over-all upward trend of 13 per cent. Registration in engineering in the four Western provinces has climbed rapidly in the past several years, at a faster rate than in the East; 36 per cent of all freshmen engineers in Canada have enrolled for study West of the Ontario-Manitoba border. Toronto came up with the largest new class, 690 strong, followed by Alberta with 476, British Columbia third with 473, and Saskatchewan next with 464. In all, 5132 new engineering students signed up in Canada in 1957.

There are some new names in the 1957 survey. Canada now has four more educational institutions offering at least a partial engineering course of recognized standing. These four are: Sir George Williams College, Montreal; McMaster University, Hamilton; Waterloo College, Waterloo; and Assumption University, Windsor. As a forecast, and discounting casualties between now and next graduation, 2130 young engineers can expect to complete their courses and enter the profession in the spring of 1958. This will be an increase of almost 17 per cent over the previous figure. How this will match up with the demand during 1958 will be watched with the greatest interest.

Keeping Codes in Proper Perspective

By R. W. Schneider[1]

THE various ASME Codes assume a place of importance in the pressure vessel industry. They represent the co-operative efforts of manufacturers, users, regulatory bodies, insurance companies, technical societies, and others.

When American pressure-vessel industry was in its infancy accident frequency was of such proportions that action became necessary. This action manifested itself in the formulation of codes representing uniformity of thinking based upon experience as well as fundamental engineering.

As the art progressed codes were revised accordingly allowing sufficient time in between so that experience could be evaluated and incorporated in the revised editions. Since their inception the primary object of the codes has been safety with due consideration to the interests of users, manufacturers, and others. The philosophy of codes may be summed up as "safety based upon experience and sound engineering practice recognizing the rights of the manufacturer to choose any design within the scope of the code."

As the industry progressed codes grew in size and scope in order to meet the growing needs. The nationwide acceptance of the pressure-vessel codes has, to a large extent, produced a tranquilizing effect and a feeling of well-being in this industry resulting in an obvious inclination toward "handbook" engineering.

Manufacturers, users, code-formulating bodies, and others can take justifiable pride in their accomplishments to date; the record speaks for itself. Progress does not stop here and the codes readily admit that their requirements are minimum and cannot possibly cover all configurations conceived by the designer or conditions required by an expanding industry. The trend toward handbook or codebook designing is painfully evident; the codes being used not only to replace engineering inventiveness but to settle arguments with respect to heat treatment, welding, brittle fracture, and a wide variety of related subjects.

For the future development of the pressure-vessel industry it behooves all of us to take our fair share of pride in the codes but, of greater importance, to place them in the proper perspective. Let them supplement sound, fundamental engineering practice but never replace it.

Growth is the backbone of American industry; this includes individual professional growth as well as industrial growth. The codes will continue to serve industry best as long as we recognize our responsibility to society and our profession; handbook or codebook designing being a deterrent to true professional growth.

[1] Engineering Division, The Travelers Indemnity Company, Hartford, Conn. Assoc. Mem. ASME.

The Woman's Auxiliary to the ASME Announces Winner of Calvin W. Rice Scholarship

AS WE approach the fall season and anticipate a productive and active year, we are sure that all ASME members, as well as Auxiliary members, will be interested in the following report from The Calvin W. Rice Memorial Scholarship Committee. Mrs. A. R. Cullimore, chairman of the committee, is efficiently assisted by Mrs. W. H. Byrne, Mrs. G. T. Felbeck, Mrs. J. W. Wilkenfeldt, and Mrs. C. H. Young; to whom the Auxiliary expresses thanks for their continued conscientious work.

The Calvin W. Rice Memorial Scholarship for 1958–1959 has been granted to Nurettin Olcer of Turkey. Mr. Olcer was chosen by the Institute of International Education in New York from applications submitted to the Scholarship Committee by students from France, Germany, Pakistan, The Netherlands, and Turkey.

Mr. Olcer is twenty-six years old, a graduate in mechanical engineering with an MS degree from the Technical University of Istanbul in June, 1956, and from the Ordnance School in Ankara in 1957. During the past year he has been serving as a lieutenant on the Scientific and Advisory and Development Board of the Turkish General Staff.

His major field is jet propulsion and he plans to take advanced courses in this field leading to a doctor's degree.

The Scholarship granted by the Woman's Auxiliary is $1500 for maintenance during one academic year of graduate study in mechanical engineering in the United States. The Institute of International Education has secured a Tuition Scholarship for Mr. Olcer at Northwestern University, Evanston, Ill., and a United States Government Scholarship to attend an Orientation Center at the University of Kansas from July 24 to September 3.

CANDIDATES FOR MEMBERSHIP AND TRANSFER IN ASME

THE application of each of the candidates listed below is to be voted on after Sept. 25, 1958, provided no objection thereto is made before that date and provided satisfactory replies have been received from the required number of references. Any member who has either comments or objections should write to the Secretary of The American Society of Mechanical Engineers immediately.

New Applications and •Transfers

Alabama

•BATHURST, LYNN L., Trussville

California

BURT, ARTHUR F., Altadena
CROALL, JOHN, Long Beach
DIAMOND, STANLEY D., Sherman Oaks
DISHINGTON, RODGER C., Glendale
EVANS, DONALD P., Castro Valley
GARRETT, PETER L., Santa Monica
•GIEDT, WARREN H., San Francisco
•GLESSNER, JOHN W., San Diego
HARVILL, LAWRENCE R., Los Angeles
JUGEND, JOSEPH N., Altadena
KAUFER, BENJAMIN W., Long Beach
LIN, TUNG H., Los Angeles
MCDONALD, ANGUS N., Emeryville
•OTTENHEIMER, RICHARD J., Visalia
•RIDGWAY, ROBERT L., Manhattan Beach
SKIDEL, DAVID S., North Hollywood
TABER, ROBERT P., Sunnyvale
WARD, GERALD T., Berkeley

Connecticut

APPLETON, LEE S., New Haven
•CHEN, LESLIE H., Groton
GIGER, WALTER, JR., Plainville
LEGIER, JOHN L., Clinton
•MCCLENATHAN, ROBERT C., 3RD, Westport
SCALO, RALPH F., Bridgeport
•WOOD, GLENN M., East Hampton

District of Columbia

SERADO, JOHN J., Washington

Florida

HOLLOWAY, BENJAMIN B., Pensacola
MCCURDY, ROBERT F., Pompano Beach
NORMAN, RICHARD P., Miami
SANNICANDRO, ROCCO A., Gainesville
WRIGHT, RAY E., Deerfield

Illinois

•BAIER, WILLIAM H., Chicago
•BOYAR, ROBERT E., Park Ridge
•BRUNNER, MILTON F., Oak Park
•THEOCARIS, PERICLES S., Chicago

Iowa

HOLMBERG, BROR F., Sac City
KNOWLES, ALLEN N., Fort Dodge
•MADSEN, DONALD H., Iowa City

Kansas

•PARHOMEK, PETE F., Prairie Village

Kentucky

METKE, ROBERT G., Paducah

Louisiana

GARROT, DONALD J., Baton Rouge
MULLER, KARL C., New Orleans

• Transfer to Member or Affiliate.

PASTOREK, RICHARD L., Baton Rouge
•PEYRONNIN, CHESTER A., JR., New Orleans

Maryland

ANDREWS, DONALD E., Cambridge
BECHTEL, CHARLES B., Baltimore
•SYLVANUS, ROBERT F., Baltimore

Massachusetts

COPPIN, PHILIPPE, Worcester
EGGINSON, HOWARD G., Boston
HOLLICK, JOHN G., Salem
SHANG, TING-LIN, Boston

Michigan

AUZINS, RAIMUNDS, Muskegon
FORD, LESLIE S., Dearborn
HARTWELL, KENNETH W., Detroit
SPERRY, JAMES L., Detroit

Minnesota

•BLOODGOOD, BRICE, Rochester
IVERSON, OLIVER N., Minneapolis
PAULSON, DONALD C., St. Paul

Missouri

•BRIDGES, RONALD P., Centralia
KIBURZ, JACK V., St. Louis
MONIER, CHARLES J., Kirksville
VORNHOLT, WILLIAM A., JR., St. Louis

New Hampshire

•REEKIE, WILLIAM R., Peterborough

New Jersey

DREW, RENE E., Hasbrouck Heights
MARTIN, GEORGE J., 3RD, Bayonne †
NESS, IRVING S., Princeton
PAGE, ROBERT H., Hoboken
PAULISON, WILLIAM L., JR., Ridgewood
VAN BENSCHOTEN, RICHARD P., Brunswick
VIERNO, LOUIS C., Cresskill

New York

BARRANGON, MAURICE, White Plains
•BURNS, JOHN J., JR., Plainview, L. I.
FLORMAN, MONTE W., Queens Village
GOLDBERG, SEYMOUR, Bronx, New York
HARPER, WILLIAM Z., Rochester
HINES, ROBERT F., Fishkill
KAO, SHOU, New York
•LEVENSON, ROBERT S., Plainview
NEIGHBORGALL, ROGER B., New York
O'BRIEN, CARROLL J., Plainview, L. I.
•REES, WERNER A., Schenectady
•REESE, ROBERT C., Corning
•THOMPSON, WILLIAM E., Buffalo
•TRUEBIG, RAYMOND F., Uniondale

North Carolina

•MCDONALD, PATRICK H., JR., Raleigh

Ohio

ANDERSON, ROBERT G., Cincinnati
BIGGS, ROBERT R., Toledo
BORGMANN, EARL A., Cincinnati
COURTNEY, WILLIAM J., Cleveland Heights
CURTIS, ROBERT W., Alliance
•DEININGER, RICHARD D., Hamilton
DETWILER, FRANKLIN L., Brecksville
DIRR, RICHARD L., Cincinnati
•DRYER, MURRAY, Cleveland
•FOSTER, SEYMOUR R., Akron
HAWK, ALFRED L., JR., Barberton
•KOPP, BERNARD L., Cincinnati
LANKTON, CLARK S., JR., Wyoming, Cincinnati
LARCHER, BASIL C., Wadsworth
•MALONEY, JAMES D., JR., Chillicothe
•MOEGLING, JOHN R., Canton
MURPHY, ALFRED J., Cincinnati
RUTHERFORD, GEORGE A., JR., Eastlake
SCHWIERS, WILLIAM W., Cincinnati
SMITH, WILLIAM N., New Philadelphia
WOOD, RUTSON L., Cincinnati
•ZEIDMAN, GORDON G., Columbus

Pennsylvania

CLARK, CHARLES C., Erie
DOWNS, JOHN, Philadelphia
FAIR, JOHN S., JR., Philadelphia
FINK, RALPH W., Pittsburgh
•KISCADEN, ROY W., Springfield
•KUH, LOUIS M., Pittsburgh
•KUSNERUS, JAMES L., Allentown
•THOMAS, CARL D., Pittsburgh
TURNER, ELTON W., Wayne
WISHART, WILLIAM M., North East

South Carolina

•MCCALLEY, GRAY, Columbia

Keep Your ASME Records Up to Date

The ASME Secretary's Office depends on a master membership file to maintain contact with individual members. This file is referred to countless times every day as a source of information important to the Society and to the members involved. All other Society records are kept up to date by incorporating in them changes made in the master file.

The master file also indicates the Professional Divisions in which members have expressed an interest. Many Divisions issue newsletters, notices of conferences or meetings, and other material. You may express an interest in the Divisions (no more than three) from which you wish to receive any such information which might be published.

Your membership card includes key letters, below the designation of your grade of membership and year of election, which indicate the Divisions in which you have expressed an interest. Consult the form on this page for the Divisions to which these letters pertain. If you should wish to change the Divisions you have previously indicated, please so notify the Secretary.

It is highly important to you and to the Society to be certain that our master file indicates your current mailing address, business or professional-affiliation address, and interests in up to three Professional Divisions.

Please complete the form, being sure to check whether you wish mail sent to your residence or office address, and mail it to ASME, 29 West 39th Street, New York 18, New York.

Please Print

ASME Master-File Information

Date _____

LAST NAME _____ FIRST NAME _____ MIDDLE NAME _____

POSITION TITLE _____ NATURE OF WORK DONE _____
e.g., Design Engineer, Supt. of Construction, Manager in Charge of Sales, etc.

NAME OF EMPLOYER (Give name in full) _____ Division, if any _____

*☐

EMPLOYER'S ADDRESS _____ City _____ Zone _____ State _____

ACTIVITY, PRODUCT, or SERVICE OF EMPLOYER, e.g. Turbine Mfrs., Management Consultants, Oil Refinery Contractors, Mfr's. Representative, etc.

*☐

HOME ADDRESS _____ City _____ Zone _____ State _____

☐

PRIOR HOME ADDRESS _____ City _____ Zone _____ State _____

* CHECK "FOR MAIL" ADDRESS

I subscribe to

Address changes effective when received prior to:

☐ MECHANICAL ENGINEERING	10th of preceding month
☐ Transactions of the ASME	20th of preceding month
☐ *Journal of Applied Mechanics*	20th of preceding month
☐ *Applied Mechanics Reviews*	1st of preceding month

Professional Divisions in which I am interested (no more than *three*) are marked X.

☐ A—Aviation	☐ J—Metals Engineering	☐ S—Power
☐ B—Applied Mechanics	☐ K—Heat Transfer	☐ T—Textile
☐ C—Management	☐ L—Process Industries	☐ U—Maintenance and Plant Engineering
☐ D—Materials Handling	☐ M—Production Engineering	☐ V—Gas Turbine Power
☐ E—Oil and Gas Power	☐ N—Machine Design	☐ W—Wood Industries
☐ F—Fuels	☐ O—Lubrication	☐ Y—Rubber and Plastics
☐ G—Safety	☐ P—Petroleum	☐ Z—Instruments and Regulators
☐ H—Hydraulics	☐ Q—Nuclear Engineering	
	☐ R—Railroad	

Tennessee

●Brown, Van T., Nashville
●Price, Milton M., Camden

Texas

Birtell, James C., Borger
Brown, Loyal G., Freeport
●Cheatham, John B., Jr., Houston
Crews, Sam T., Jr., Midland
Feeser, John R., Houston
Fletcher, Carney B., Baytown
Green, Robert C., Houston
Jacobsen, Berry O., Canyon

Vermont

●Krauss, Paul, Burlington

Virginia

●Blow, Edward B., Norfolk

Washington

Keplinger, Elmer R., Kennewick
La Velle, Eugene B., Kennewick
●Nitteberg, Leland J., Kennewick
●Wyatt, Charles C., Seattle

West Virginia

Gilbert, Jack D., Boomer
●Kramer, David B., Charleston
●Penley, Percy A., Point Pleasant

Wisconsin

Brooks, Melvin H., Milwaukee
Ford, Ralph L., Fond du Lac
●Krahn, Earl G., West Allis
Vermes, Geza, Milwaukee

Foreign

O'Hara, William I., Vancouver, B. C., Canada
Palmer, Peter J., Wolverhampton, Staffs, England
Reiner, Thomas, London, England
Sundaresan, Manakal N., Bangalore, India
van der Schaaf, Hendrik, Maracaibo, Venezuela, S. A.
Yamanaka, Hideo, Konohana, Osaka, Japan

ENGINEERING SOCIETIES PERSONNEL SERVICE, INC
[Agency]

These items are from information furnished by the Engineering Societies Personnel Service, Inc., in co-operation with the national societies of Civil, Electrical, Mechanical, and Mining and Metallurgical Engineers. This Service is available to all engineers, members or nonmembers, and is operated on a nonprofit basis.

In applying for positions advertised by the Service, the applicant agrees, if actually placed in a position through the Service as a result of an advertisement, to pay a placement fee in accordance with the rates as listed by the Service. These rates have been established in order to maintain an efficient nonprofit personnel service and are available upon request. This also applies to registrant members whose availability notices appear in these columns. Apply by letter, addressed to the key number indicated, and mail to the New York office.

When making application for a position include eight cents in stamps for forwarding application to the employer and for returning when necessary. A weekly bulletin of engineering positions open is available at a subscription of $3.50 per quarter or $12 per annum for members, $4.50 per quarter for nonmembers, payable in advance.

NEW YORK	CHICAGO	DETROIT	SAN FRANCISCO
8 West 40 St.	84 East Randolph St.	100 Farnsworth Ave.	57 Post St.

Men Available[1]

Mechanical Engineer, design or manufacture, BSME; 33; five years' design experience on heavy equipment and aircraft controls; one year estimating on coke and chemical plants; one-and-one-half years manufacturing engineer on nuclear components. Prefers eastern U. S. but will go anywhere in the U. S. Me-624.

Chief Engineer, BSME, 32; 11 years' experience, seven as chief engineer and other supervisory levels. Self-starter with initiative; flexible; communicates well; cost conscious; covers product design, light through heavy machinery. Anywhere in U. S. Me-625.

Chief Industrial Engineer, BME; 39; eight years' experience as supervisor of time-study men, methods engineers, tool designers, and estimators. Good organizer, cost conscious, with excellent metalworking experience. Certified in work-factor predetermined times. Prefers Midwest. Me-626-9825-Detroit.

Research and Development Engineer; registered PE; 46; five years' experience in machine and tool design; eight years as independent inventor of mechanical, hydraulic, and electronic applications; two years industrial research and development. Prefers Midwest and Southwest. Me - 627-9824-Detroit.

Recent Graduate Engineer, BSIE; 25; general engineering experience related to powdered-metal parts manufacture and magnetic ferrous alloys, particularly material development and testing. Desires opportunity for professional advancement in production engineering or manufacturing design. Location optional. Me-628-9783-Detroit.

Design Engineer, BSME; 36; four years design of chemical-processing machines including layout; continuous mixers, extruders, and pelletizers for foods and plastics. Three years design of equipment and piping for nylon intermediates and spinning plants. Prefers northern Midwest area. Me-629-9849-Detroit.

Technical Sales, Administrative Manager, BSME; 37; mechanical engineer seeks responsibility; desires to represent/join staff progressive industry offering opportunity; 15 years' proved operational experience in engineering sales, administration for aircraft, missiles, marine, and special fabricated equipment. Prefers foreign or domestic. Me-630.

Plant Engineer, BSME, PE; 34; experienced in utility operation, power generation, steam and diesel; municipal water-plant operation and design; automatic dial-telephone system; supervision of professional employees in construction and maintenance-design work. Now employed in construction phase of one of the largest domestic mining developments. Desires permanent position. Me-631-883-Chicago.

Manager, Chief Engineer, Senior Design Engineer, BSME, hydraulics; 47; machine design (heavy), ten years; chief engineer, chief design engineer, ten years, management, five years; machine shop, foundry, fabrication all types, pressure vessels, structural, paper and pulp equipment, textile, etc. Prefers Midwest, East, or South. Me-632-9855-Detroit.

[1] All men listed hold some form of ASME membership.

Positions Available

Assistant Professor, PhD in ME, young, to teach courses in thermodynamics and allied subjects to junior and senior undergraduates and to graduate students in the master-of-science program. New England. W-6360.

Plant Manager, preferably industrial engineer, mature, to reorganize graphic arts plant. Must have had considerable experience in the graphic arts and preferably have some knowledge of cold-type process. Leadership qualities are paramount with background in promotion, systems, methods; personnel relations extremely important. Salary open. Apply by letter stating minimum salary requirements. Pa. W-6364.

Materials-Handling Engineer, graduate mechanical, but will consider a graduate chemical or industrial engineer, some experience in the chemical industry; materials-handling experience with such items as bulks, liquids, and packages is desirable. Must be able to carry through on assigned projects. This is a staff position with some travel to diversified manufacturing plant facilities throughout the United States and Canada. $9000–$12,000. Midwest. W-6373.

Valve-Design Engineer, college degree in engineering or equivalent experience; several years' actual design experience in the valve field. Must have a strong interest in the practical, industrial aspects of mechanical engineering. Excellent opportunity with a growing company. Salary open. Company reimburses applicant for placement fee. Ohio. W-6374.

Chief Process Engineer, graduate, to head up process development of a plant processing 60,000 tons of crude ore, reduce costs. Must be familiar with crushing, grinding, magnetic separation, filtration. $12,000. Midwest. W-6380.

Engineers. (*a*) Design engineer, preferably graduate mechanical, two years' or more experience in paper-converting machinery, plastics-processing machinery, or metal-strip rolling or processing machinery. Salary open, depending upon experience. (*b*) Supervisor of mechanical development, experienced in one of the above, some experience also in power transmission. Must have a minimum of five years' development experience to supervise department. Salary open. Central N. J. W-6386.

Chief Engineer, heavy mechanical background, for manufacturer of mining equipment. Salary open. Midwest. W-6389.

Sales Engineer, graduate mechanical, two to five years' good selling experience on equipment used in the power industry, either industrial or utility-steam plants. $7200, plus sales and profit-sharing bonus. Western Pa. W-6392.

Project Engineer, work in research and development for company manufacturing pulp and paper machinery and equipment, graduate mechanical, five years' experience as a mechanical engineer including a minimum of two years as a machinery designer or two years in the pulp and paper industy. Duties will include design and development of new products, redesign, modernization, and further development of existing products; design and conducting of experiments intended to test and develop new designs. To start, $8000–$8500. Mass. W-6394.

Engineers for plastics manufacturer. (*a*) Assembly supervisor to take complete charge of the extrusion department. (*b*) Production supervisor for assembly operations; responsibility will be to take care of finishing operations. Permanent positions. Apply by letter giving complete information, including salary requirements. New England. W-6398.

Director of Engineering, graduate mechanical, ten years' or more experience in plant engineering and/or centralized engineering organization handling new construction, plant-equipment layout, and design, etc. Should have good working knowledge of corporate capitalization methods and of operating cost reporting. About $12,000. Central N. J. W-6399.

Engineers. (*a*) Project engineers, graduate mechanical preferred but will consider degree in other sciences if applicant has sufficient mechanical experience. Minimum of ten years' experience in development of automatic and special process-machinery development and application of control equipment. Must have heavy mechanical background and conversant knowledge of electronics. $10,300–$11,500. (*b*) Design engineers, graduate mechanical, previous experience in the design of automatic and special machinery; typical experience would be as a machine designer on packaging, or metal-stamping machines, or other mechanical machinery such as used in the printing or textile industries. $8200–$9500. Company will negotiate placement fees; pays all expenses for interviews. Conn. W-6404.

Senior Machine and Equipment Designer, engineering graduate, at least ten years' design, layout, and detailing experience covering manufacturing and processing machinery and equipment. Position is with consulting firm and requires creative type to sit at drafting table and conceive new devices, new methods and approaches to older less economical ways. Salary open. Va. W-6405.

Engineers. (*a*) Assistant production engineer, seven to ten years' experience in manufacture and design of electromechanical equipment. $10,000, plus. (*b*) Project engineer, graduate mechanical, chemical, or electrical,

(*ASME News continued on page 122*)

ONLY WELBOND® COMBINES ALL THESE VALVE FEATURES

These features have won immediate approval for Yarway Welbond Valves in steam power plants everywhere. Now available in 9 sizes, $\frac{1}{4}$" to $2\frac{1}{2}$", angle and straightway. Pressures to 2500 psi, temperatures to 1050°F. Write for Bulletin B-453.

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NEW VENTILATED HANDWHEEL
GUIDED STEM OF #321 STAINLESS STEEL —will not "pit". Self-aligning valve disc
HIGH TEMPERATURE INHIBITED STEM PACKING —furnishes double insurance against packing leaks.
ONE-PIECE BODY AND YOKE
ACCESSIBILITY —all working parts readily removed through yoke. Jack action of stem forces out old packing.
UNIQUE SEAT DESIGN Thermal compensating groove prevents distortion when welding valve in line and permits perfect seating of disc for positive seal.

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REPRESENTATIVE USERS OF YARWAY WELBOND VALVE: Houston Lighting & Power Co. Jersey Central Power & Light Co. Boston Edison Co. Virginia Electric & Power Co. Connecticut Light & Power Co. City of Independence, Mo. Aluminum Co. of America City of Pasadena, Calif. Mississippi Power & Light Co. Rochester Gas & Electric Corp. Ohio Edison Co. Central Hudson Gas & Electric Corp.

three to five years' experience in electromechanical equipment particularly applying to processed-paper industry. Upstate N. Y. W-6416.

Engineers. (*a*) Cryogenic engineer, five to ten years' industrial experience with emphasis on development work. Should have experience in heat transfer, thermodynamics, and fluid flow which can be applied to a variety of engineering problems. Experience in design and fabrication of mechanical and process equipment desirable. Salary open. (*b*) Mechanical engineer/physicist. MS or PhD in engineering or physics, interest in fields of mathematical physics, radiation, temperature measurement, thermodynamics, heat transfer, electronics. High-temperature research projects for government and industry. Salary open. (*c*) Senior mechanical or chemical engineer, eight to ten years' in aerodynamics, rocketry, or allied fields. Will handle major project responsibility in a wide variety of problems dealing with weapon and space technology. Typical problems include solid-propellant rocket systems development, instrumentation for upper atmosphere research and satellites, rocket-test equipment, and aerodynamic drag devices for re-entry. Opening not for a production or chemical-process man or just a mechanical engineer. Salary open. Positions with a research firm. Mass. W-6419.

Research and Development Engineer, mechanical or electrical graduate, five years' experience on the development of electromechanical devices, particularly as to household appliances. $7200–$7800. Conn. W-6427.

Recent Graduate Engineers, work in quality-control department of a large corporation; should have at least a minimum familiarity with welding; will enter a three-month concentrated training program for quality control. This program will include welding, radiography, and non-destructive testing techniques. Around $6000. Company pays placement fees, interview, and relocation expenses. Various locations throughout United States. Headquarters, East. W-6429.

Engineers to direct design and development programs for aircraft accessories. (*a*) Engineer, hydraulic pumps and systems, BSME, eight to 12 years' experience in hydraulic and pneumatic fields. Will supervise analysis, design, and development of hydraulic pumps, systems, and components applicable to aircraft hydraulic installations; must be capable of supervising work of project engineers; assume complete responsibility for design of piston-type pumps, gear-type pumps, hydraulic systems, and their several components. $9000–$12,000. (*b*) Engineer, controls, BS in mechanical or electrical engineering; graduate degree desirable, eight to ten years' experience in servomechanisms and the evaluation of control loops and systems. $8000–$10,000. (*c*) Mechanical engineer, graduate, six to eight years' experience in combustion processes. Must have sound theoretical background in thermodynamics and mechanical design in addition to thorough knowledge of combustion processes as applied to gas turbines. $8000–$9000. (*d*) Design engineer, graduate mechanical, eight to 12 years' experience in the design of aircraft engines or accessories. Must be capable of initiating, developing, and completing the design of a unit or component of a system from the specifications and requirements laid down by customer; must be thoroughly conversant with all manufacturing techniques and have a thorough background in stress analysis and strength of materials. $8000–$10,000. Upstate N. Y. W-6430.

Engineers. (*a*) Senior mechanical engineers, BS or MS in ME, three or more years in the actual design and production problems relating to electromechanical components. Thorough knowledge of fundamental gyro principles, machine-shop practices, and in the analysis of designs for producibility. Will be responsible for leading projects involving the modification and redesign of mechanical devices such as gyros, accelerometers, and servos. From $7200. (*b*) Product engineers, BS or MS in EE preferred but BSME or MSME acceptable if sufficient electronics exposure. Three to four years' experience in product engineering or design and development of gyros, accelerometers, or related instruments. Knowledge of machine and process capabilities and limitations. Will have engineering responsibility for production of precision miniature rate gyros; handle engineering functions or problems in assembly processes, tooling, machines, equipment tool costs, etc. From $7920. Mass. W-6436.

Methods Engineer, ME or IE degree, additional training in electromechanics and instrument-production techniques; three to five years' experience in the methods and processing of electromechanic and electronic components for machine-shop and assembly operations. Duties will include planning from initial concept to follow-up; write process sheets; lay out process prints, tool scheduling, machine loading, develop standard data, etc. $7200. Mass. W-6437.

Production Manager, Transformer Plant, for fast-growing manufacturer of power and light distribution transformers. Must be capable of assuming full responsibility for production, production control, and personnel supervision. Knowledge of all phases of transformer production necessary. Position will ultimately result in position of vice-president in charge of manufacturing with stock option. Midwest. W-6438C.

Sales Engineers. (*a*) Sales engineer, aircraft hydraulics, inside sales; degree in mechanical or aeronautical engineering preferred; strong background and interests along engineering lines. Experience in aircraft or missile industry or in industry supplying aircraft products. Direct experience with projects involving use of hydraulic components; experience in paper work and procedures involved in aircraft component procurement. To $8500. Relatively little travel. Upstate N. Y. (*b*) Sales engineer, degree in metallurgical, mechanical, or general engineering, from none to five years' experience in metal-casting sales. Recent graduate acceptable but prefer some foundry experience. Work will be in sales of precision cast, high-strength steel, and iron castings. Involves contact with development and engineering personnel regarding problems involved in casting design and application. To $7800, for experienced sales engineers. Ill. Company may negotiate placement fees. W-6445.

Mechanical or Electrical Engineer, recent graduate, interested in a career in Latin America with an electric light and power company. One-year training period prior to going to Latin America. Should have potential for eventual advancement to management position. Starting salary commensurate with qualifications. F-6449.

Manufacturing Executive for manufacturer of pipe fittings for power plant and oil refinery, usage. Must know equipment and methods; be able to plan and direct entire operation; recommend process, equipment and methods changes; train personnel; control quantity, quality, and costs of production. Excellent opportunity for advancement. Starting salary in accord with present qualifications. Relocation costs paid; placement fee a negotiable item. Apply by letter giving experience, abilities, education, and salary requirements. Midwest. W-6451C.

Design Engineer, graduate mechanical or aeronautical engineer, two to four years performance analysis, mechanical, or aerodynamic design; experience with subsonic and supersonic aircraft. Duties will include responsibilities for conducting performance and mission analysis to select optimum engine parameters for existing and future propulsions systems; analyzing power-plant-component design for applications to new and special devices. To $11,000. New England. W-6460.

Project Engineer, graduate mechanical, at least four years on heat-exchanger design and calculations. Experience with ASME Unfired Pressure Vessel Codes; knowledge aluminum welding, soldering, and brazing. Duties will include design and development of heat-exchange devices for industrial uses servicing the air-separation industry. Prepare project for manufacture by product design and analysis, material, component and process investigation, schedule tests, and evaluate test data; effect design changes, maintain vendor and customer controls and relationships to assure completion of projects, for a manufacturer of heat-exchange devices for aircraft and commercial uses. Salary open. Southern Ind. C-6926.

Engineers. (*a*) Assistant engineer or superintendent of facilities, graduate mechanical or chemical; at least five years in maintenance of equipment in process industry, to supervise all mechanical and electrical facilities in process plants, yards, equipment buildings, and grounds. Must have good, strong forceful personality. $9600. (*b*) Assistant production superintendent experienced in process field, to be understudy for eventual position of plant manager. Ability to handle personnel at all levels in plant and office. $9000. Company will pay placement fees. Southern Wis. C-6927.

Mechanical Engineers, Public Works, ME degree or equivalent, eight years' experience mechanical engineering, four of which must have been on managerial or supervisory level. Thorough knowledge of design and installation of heating systems, water-distribution systems, steam-power plants, sanitation systems, and refrigeration systems. Capable of directing and participating in preparation and review of plans, specifications, bills of materials, cost estimates, programming, and scheduling for construction. Advise and assist in planning, design, preparation of plans, specifications and estimates, construction, installation, and maintenance of heating and plumbing systems, refrigeration, and air-conditioning equipment, steam power plants, etc. $10,800–$12,000. Korea. S-3681.

Sales Engineer, electromechanical, graduate mechanical or electrical, well qualified by training or experience to sell directly to industrial users and/or O.E.M., a product-application job on electrical portable furnaces, electromechanical devices, testing, equipment, automatic controls for established manufacturers' agent with San Francisco headquarters and offices throughout the West. Knowledge of metallurgy desirable. To $6600, plus profit sharing, expenses and car mileage, benefits. San Francisco, Calif. S-3705R.

Field and Office Engineer, mechanical and construction; solid experience in field and office work relating to general construction and piping for powerhouses and heavy-test cell work (compressors, pumps). Will take care of submittals, field and office engineering and detailing, layout relative to installation of heavy equipment. Also related to concrete-forms design, keep track of costs, time, progressing, expedite materials, and keep materials controls. Report to project manager. Able to handle responsibility and have good knowledge of mechanical installations (heavy machinery, equipment, piping) work in field-construction office. About $9600. Utah. S-3715.

Sales Engineer, Steam-Plant Products; mechanical or electrical, minimum of five years' experience selling direct, preferably boiler-plant equipment and supplies to industry (chemical, food, or any plant with boiler plant). Will sell steam-plant controls, meters, valves, glasses, traps, for established manufacturers' agent. Need car. Compensation on draw, salary, or percentage basis; potential excellent. San Francisco Bay area and central Calif. S-3719R.

Junior Mechanical and Electrical Engineer, public works; graduate mechanical or electrical, knowledge of principles of mechanical and electrical engineering, methods, materials, as applied to design, construction, inspection, and testing; able to do drafting for mechanical and electrical installations; for all phases of mechanical and electrical engineering connected with port, airport, and industrial operations. $6000–$7500. San Francisco East Bay area. SG-3719.

Service and Installation Engineer, Diesels, mechanical graduate, either a recent graduate or some experience, to provide installation and service to user-clients (mines, tugs, trucks, logging, construction). Should have interest and liking for internal-combustion engines and be willing to do such work with tool as required in the field. Will learn to figure and quote on jobs as he goes along. For a manufacturer's distributor. $5400–$6000, and up, depending on qualifications, plus expenses. Car required. Headquarters, San Francisco, Calif.; territory, northern Calif. area. S-3721R.

Junior Engineers, BS in ME, EE or IE, preferably recent graduates, some knowledge of electronics, to work under chief engineer of manufacturer of insulated conductors. May be assigned to design, test, or production problems of growing company. Opportunity for advancement. $5400–$6000. San Francisco Peninsula. S-3729.

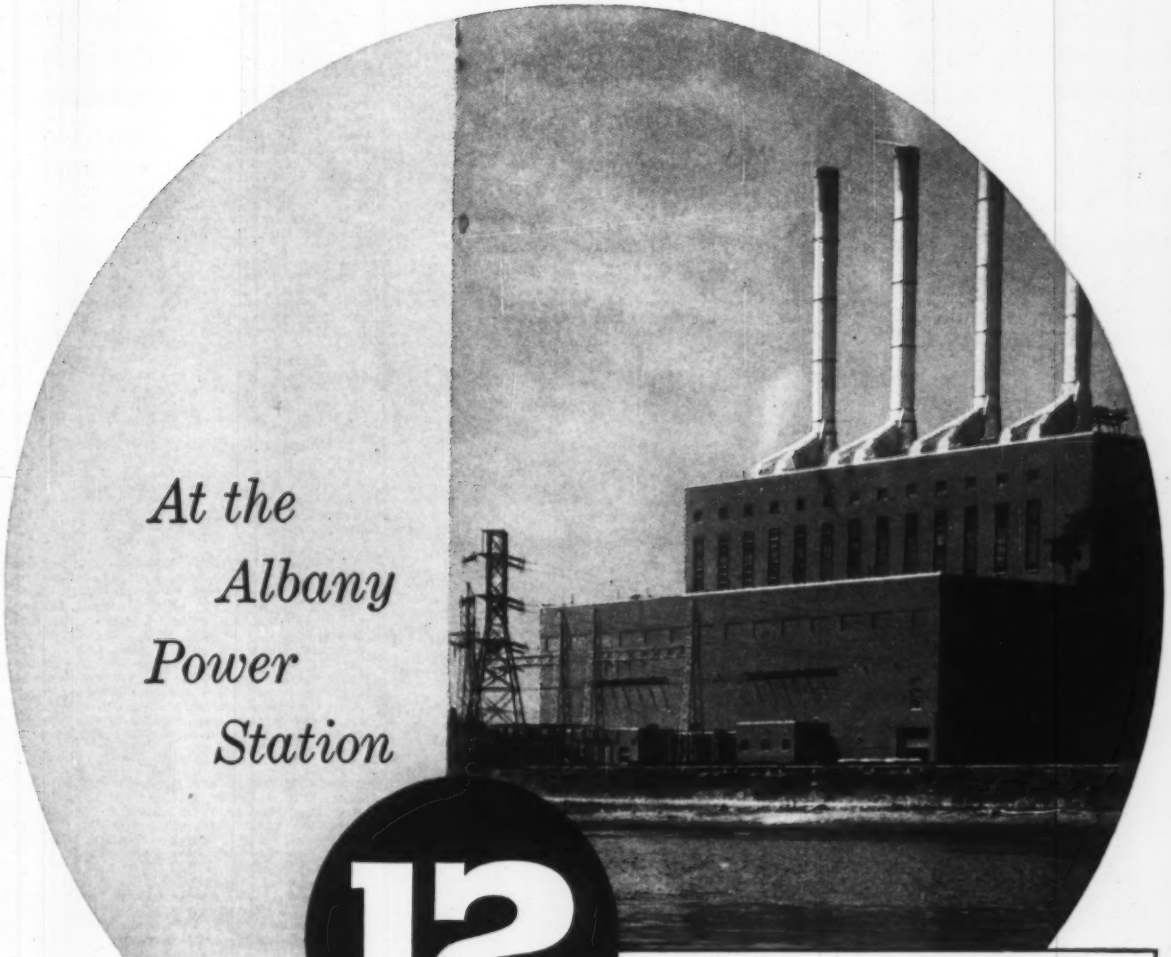
Design Engineer, heating, ventilating, refrigeration, and air conditioning, graduate mechanical, five years' experience in design and supervision of mechanical-engineering projects. Design of refrigeration, air conditioning, ventilating, dehumidification, plumbing, water services, sewage, heat, piping, power generation, controls, fire protection, cold storage, food-processing design work. $9600–$12,000. Position with a construction company. Hawaii. S-3733R.

OBITUARIES

Charles Thomas Brown (1912–1958), chief engineer, Columbia-Southern Chemical Corp., Corpus Christi, Texas, died May 18, 1958. Born, Houston, Texas, April 18, 1912. Education, Texas A&M College, attended Rice Institute for three years, BS(ME), 1933. Mem. ASME, 1953. He had been associated with Columbia-Southern since 1933. Mr. Brown had also been a lay minister of the Church of Christ since 1929, more recently he has been preaching in the Church of Christ at Bayside, Texas. He was a member also of AIEE. Surviving are his wife, Elizabeth; two daughters, Janice Elaine and Virginia Nell; his parents, Mr. and Mrs. R. M. Brown; and three brothers, Harry K., Walter A., and William E.

William Albert Chryst (1877–1958), retired consulting engineer and formerly chief engineer, Delco Products Division, General Motors Corp., Dayton, Ohio, died June 4, 1958. Born, Dayton, Ohio, Oct. 21, 1877. Education, public schools.

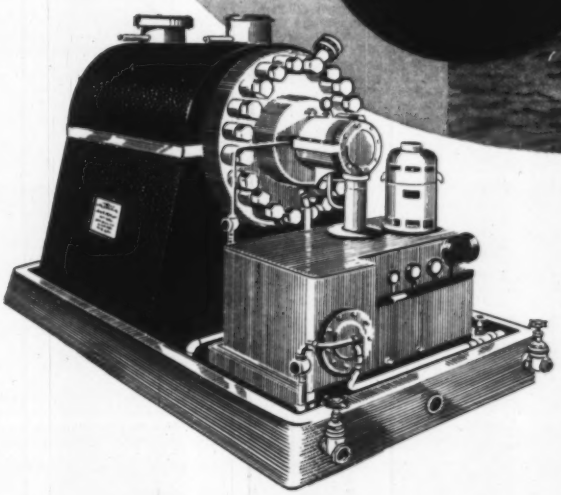
(*ASME News continued on page 124*)



At the Albany Power Station

12

Pacific Boiler Feed Pumps Serve NIAGARA MOHAWK



Following the original installation of 6 Pacific Type BFI Boiler Feed Pumps in 1951 Niagara Mohawk added a battery of 3 Pacific Boiler Feed Pumps in 1952—and 3 more in 1953.

This record of repeat orders (one of many similar records) provides hard, factual evidence as to the dependability, efficiency and excellent design built into every Pacific high pressure high speed boiler feed pump. For additional data on these reliable pumps write for Bulletin 122.

PACIFIC

BF-28

PACIFIC PUMPS INC.

A Division of Dresser Industries, Inc.

HUNTINGTON PARK, CALIFORNIA

Married Susan A. Lehman, 1902. Mem. ASME, 1917. Mr. Chryst, with Charles F. Kettering, Fellow ASME, and Col. E. A. Deeds, Affiliate ASME, was a coinventor of the automotive ignition system. Their work began in 1908 and shortly thereafter the group formed the Dayton Engineering Laboratories Co., now the Delco Division of General Motors. Early in his career, Mr. Chryst had been with the National Cash Register Co. He held many patents on cash-register mechanisms, electrical starting and ignition devices, hydraulic shock absorbers, and such.

Henry H. Clute (1907–1957), senior engineer, Division of Industrial Safety, State of California, Los Angeles, Calif., died Oct. 2, 1957. Born, Earlville, Delaware County, Iowa. Education, attended University of Michigan, University of California, and University of Texas. Mem. ASME, 1951. Mr. Clute had been concerned with law enforcement relative to safety orders inclucing design, construction, and installation of fired and unfired pressure vessels.

Henry Walcott Crowell (1877–1958), retired for ten years, Royal Liverpool Insurance Company, New York, N. Y., died May 28, 1958. Born, Newark, N. J., Sept. 6, 1877. Parents, Joseph G. and Laura C. Crowell. Education, BS(ME), Stevens Institute of Technology, 1899. Married Blodwen Sauvage, 1902 (died 1950). Mem. ASME, 1912. Survived by three sons, Gordon W., Harold Laurence, and James Donald Crowell.

James Joseph Ferrari (1899–1958), sales-application engineer, B. F. Sturtevant Division, Westinghouse Electric Corporation, New York, N. Y., died May 23, 1958. Born, New York, N. Y., Oct. 22, 1899. Parents, Gerald and Rose Ferrari. Education, BS(ME), Stevens Institute of Technology, 1921. Married Florence M. Garbarino, 1924. Mem. ASME, 1946. Mr. Ferrari had been a member of Tau Beta Pi. He is survived by his widow; and three daughters, Mrs. Clare Sachs, New Orleans, La.; Mrs. Ruth Patterson, and Miss Lucella Ferrari, New York, N. Y.

Walter Ferris (1868–1958), cofounder, vice-president, and consulting engineer, The Oilgear Co., Milwaukee, Wis., died April 16, 1958. Born, Rancocas, N. J., March 21, 1868. Parents, David and Sarah Ann Ferris. Education, BS(ME), Lehigh University, 1895. Married Hannah B. Price, 1896; three children, John Price, Walton Canby, and Mrs. Sarah Morey Baker. Married 2nd, Lucy A. Trowbridge, 1928. Mem. ASME, 1907; Fellow ASME, 1947. Hydraulic power transmission had been one of Mr. Ferris' chief interests. With E. K. Swigaft in 1921, he founded the Oilgear Co. He was the inventor of the hydraulic feed controller, the basis for push-button control of mass-production machines. He designed the first hydraulic broaching machine. The basic inventions covering all Oilgear pumps, motors, and transmissions were made by him. He held over 140 patents assigned to the Oilgear Co. He was the author of numerous papers pertaining to the fluid-power industry. Two of the more important of these were "Applications of Hydraulic Transmission Variable Speed Drive to Machine Tools and Manufacturing Processes" and "Symposium on Hydraulic Feeds for Machine Tools." These papers were presented at ASME Annual Meetings in 1922 and 1927, respectively. He was a member also of SAE, AOA, AAAS, and Tau Beta Pi.

Herbert Stevenson Fullerton (1877–1958), retired consulting engineer, Springfield, Pa., died March 8, 1958. Born, Philadelphia, Pa., Feb. 22, 1877. Education, attended evening classes, Drexel Institute of Technology, 1900 to 1908. Married Mae Palmer. Mem. ASME, 1946. Mr. Fullerton had formerly been chief engineer with the Southwark Division, Baldwin Locomotive Works, Eddystone, Pa. He entered his own consulting practice in 1946. He was a member also of the American Society for Testing Materials. Survived by a son, Herbert P. Fullerton.

William Francis Funk (1870–1958), chairman of the board, La Crosse Trailer Corp.; vice-president and director, La Crosse Rubber Mills, La Crosse, Wis., died May 13, 1958. Born, La Crosse, Wis., Sept. 27, 1870. Parents, Michael and Anna (Grams) Funk. Education, BS(ME), University of Wisconsin, 1891. Assoc-Mem. ASME, 1892; Mem. ASME, 1905. The La Crosse Trailer Corp., under the direction of Mr. Funk, pioneered in the development of low-bed trailers in 1932; by 1943 the company was producing trailers on the assembly lines. In the past two years, Mr. Funk took an active part in the perfection of a production model of the Cunningham Hay Conditioner. The Society in 1957 presented him with a special certificate for 65 years of service. Survived by two sisters, Mrs. S. Y. Hyde and Mrs. William H. Funke.

Charles Otto Gunther (1879–1958), leading ballistics expert and emeritus-professor of mathematics and ordnance engineering at Stevens Institute of Technology, died June 8, 1958. Born, New York, N. Y., May 21, 1879. Parents, Otto and Anna (Eybel) Gunther. Education, BS(ME), Stevens Institute of Technology, 1900; hon. DS, 1950. Married Beatrice Disbrow, 1901 (died 1952). Jun. ASME, 1900; Assoc-Mem. ASME, 1905; Mem. ASME, 1919. Professor Gunther joined the Stevens faculty in 1900 and retired after 50 years of service, in 1950. From 1908 to 1936, he was professor and head of the department of mathematics; and he was professor of mathematics and ordnance engineering from 1936 to 1950. Dean of student activities from 1920 to 1925, Professor Gunther was dean of sophomores in 1927 and 1928. He had originally taken up the study of ballistics as a hobby, but in 1929 The Engineering Foundation awarded him a grant of $500 for research in identification of firearms. His authority in this field has proved valuable as an aid in criminal cases to police in several states. During World War I, he corrected faults in range tables for machine guns. By redesigning the bullets, he produced a projectile of the same velocity and slightly more weight and increased the range from 2200 to 5500 yd. In 1925, Professor Gunther was commissioned an ordnance major; and in 1931 he was promoted to lieutenant colonel. Dr. Gunther received the Stevens Honor Medallion in 1940 for notable achievements in mathematics and ordnance. He was the author of the following books: "Integration by Trigonometry and Imaginary Substitution," "Principles of Firearms Identification," "Markings on Bullets and Shells Fired From Small Arms," and with his son, Jack, "Identification of Firearms From Ammunition Fired Therein." Dr. Gunther was a member also of ASCE and AOA, and a fellow of AAAS. Survived by his daughter, Mrs. Fred B. Llewellyn; and son, Jack Disbrow Gunther.

William Joseph Healy (1897–1958), sales engineer, De Laval Steam Turbine Co., Trenton, N. J., died June 3, 1958. Born, New Haven, Conn., July 9, 1897. Education, PhB, Sheffield Scientific School, Yale University, 1917. Mem. ASME, 1942. Mr. Healy had been with De Laval since 1934. He had served as a member of the Turbo Generator Standardization Committee, NEMA Steam-Turbine Section.

John Ewing Long (1899–1958), president, Franklin Balmar Corp., Baltimore, Md., died Jan. 30, 1958. Born, North Braddock, Pa., Feb. 7, 1899. Parents, Robert E. and Elizabeth M. Long. Education, BS(ME), Purdue University, 1923. Married Miss Penn, 1923; two daughters, Doris and Phyllis. Mem. ASME, 1942. Mr. Long had been author of numerous articles on locomotive poppet valves and steam distribution.

Roger Ayres Martin (1896–1958), district manager, Yarnall-Waring Co., Atlanta, Ga., died May 14, 1958. Born, St. Louis, Mo., Sept. 8, 1896. Education, U. S. Navy Steam Engineering School, Stevens Institute of Technology; BS(ME), Georgia Institute of Technology, 1917. Mem. ASME, 1944. Mr. Martin had served as a commissioned officer in the U. S. Navy during World War I. He joined Yarnall-Waring in 1929 as district manager supervising sales and service of valves, gages, expansion joints, and so on. Prior to that period, he had been concerned with all aspects of oil-mill machinery, and he had written a number of articles on the subject. Survived by his widow, Mary Martin; and a stepdaughter.

Lev A. Mekler (1894–1958), consulting engineer Petro-Chemical Process Co., New York, N. Y., died June 15, 1958. Born, Chernigoff, Russia, July 1, 1894. Parents, Ahron Roman and Elizabeth (Rubin) Mekler. Education, Harbin, Manchuria, Junior College of Commerce; BA, University of Glasgow, 1913; BS, University of California, 1919. Naturalized U. S. citizen, Chicago, Ill., 1924. Married Ethel Fox, 1921. Mem. ASME, 1944. Mr. Mekler was engaged in research, development, design, and operation of thermophysical and thermochemical processes in the petroleum refining, chemical-metallurgical, and ceramic industries. In 1919, Mr. Mekler became a combustion engineer and heater designer with Universal Oil Products, Chicago, Ill., organization that designed and placed in operation many important petroleum refining and petrochemical processes. From 1921 to 1927 he did consulting engineering in Chicago. He returned to Universal in 1927, remaining for eighteen years. In World War II, on leave of absence from Universal, he was on loan to the U. S. Government in the Petroleum Administration for Lend Lease to Russia. From 1945 until his death he was a consulting engineer, first in Palo Alto, Calif., and, from 1953 on, in New York. He held more than eighty American and foreign patents, of which more than sixty were assigned to Universal. His inventions were in the fields of thermal and catalytic processes and special equipment for them. Mr. Mekler was the author of many papers published in scientific journals. He had lectured before graduate students at the Illinois Institute of Technology and was a consultant for the Stanford Research Institute. Surviving are his widow, Mrs. Ethel Fox Mekler; a son, Arlen of Columbus, Ohio; a brother, Valentine of Jackson Heights; and a grandson.

Joseph J. Nelis (1876–1958), retired vice-president of marine department, Foster Wheeler Corp., New York, N. Y., died May 31, 1958. Born, Brooklyn, N. Y., Dec. 10, 1876. Parents, John and Mary Nelis. Education, city schools. Married Isabelle MacGillivray, 1904. Mem. ASME, 1914. Mr. Nelis had been with Foster Wheeler from 1919 to his retirement in 1940. During World War I, he had worked for the United States Shipping Board Emergency Fleet Corporation. He had been chief machinist in the U. S. Navy during the Spanish-American War. The holder of a number of patents pertaining to marine operations, Mr. Nelis also wrote several articles on the same subject. He served the Society as a member of the Metropolitan Section, Program Committee, for one term. Survived by a daughter, Mrs. Elizabeth Helbig.

William George Newton (1867–1958), retired, formerly superintendent, Peck Bros. and Co., New Haven, Conn., died March 23, 1958. Born Kent, Conn., Feb. 15, 1867. Parents, William and Lois Deane (Stone) Newton. Education, New Haven Public schools and private study in the field of hydraulics at Yale University. Married Jessie Seymour Nicherson, 1893. Mr. Newton had been head of the Harbor Board of New Haven and active in local and state political projects. Survived by his widow; a son, Ralph H. Newton; and a daughter, Mrs. Harry Madely.

Solomon Calhoon Noland (1891–1958?), whose death recently was made known to the Society had been southern manager, "Automatic" Sprinkler Corp. of America, Atlanta, Ga. Born, Louisville, Ky., Feb. 10, 1891. Education, attended high school, 2 years. Mem. ASME, 1943.

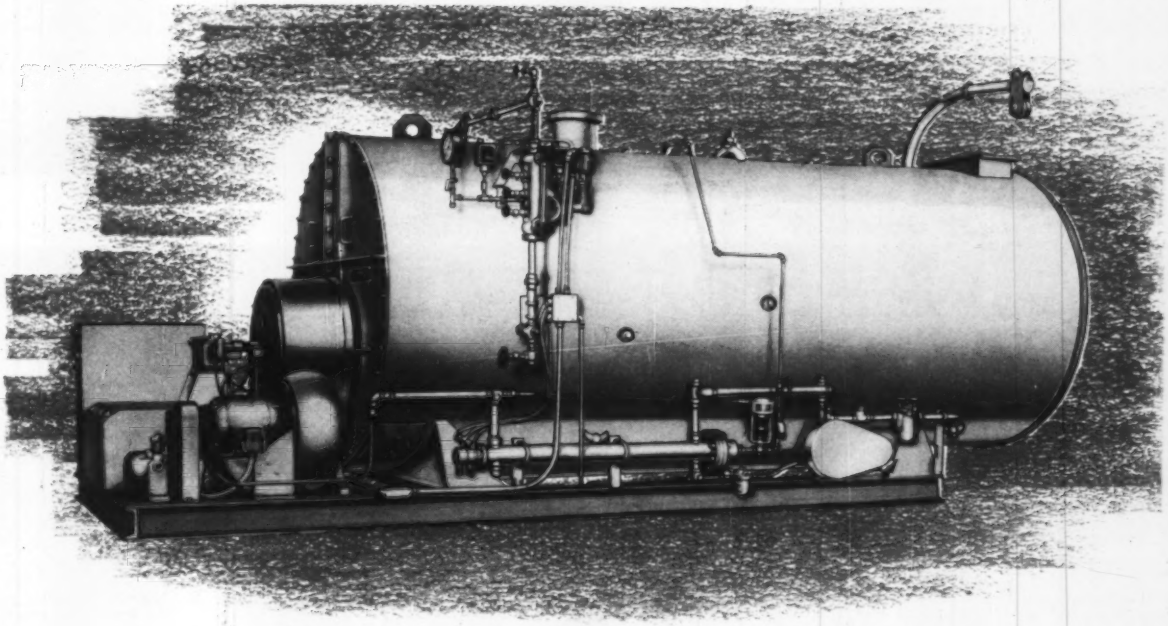
John O. Taylor (1874–1957), manager, building and equipment division, Kroehler Manufacturing Co., Naperville, Ill., died Dec. 30, 1957. Born, Tuscola, Ill., June 19, 1874. Parents, William and Mary (Cheney) Taylor. Education, BS(EE), University of Illinois, 1904. Married Anna Elizabeth Nurnberg, 1912. Mem. ASME, 1921. Mr. Taylor had been with the Kroehler Manufacturing Co. since 1920. He had been in charge of power plants, plant design, extensions, equipment for special processes, and so on. He was a registered professional engineer in the State of Iowa. Member Tau Beta Pi and Sigma Xi. Survived by his widow.

Ralph Herman Teed (1898–1958), vice-president, Arkansas Power & Light Co., Little Rock, Ark., died May 16, 1958. Born, Helena, Mont., Feb. 19, 1898. Education, BS(ME), Cornell University, 1921. Married Ferol E. Hawkes, 1926. Mr. Teed had been a specialist in the operation of public utilities. He had also been vice-president and director, Hot Springs Street Railway Co.; and director, Holly Springs Brick and Tile Co., Holly Springs, Miss. He is survived by his widow; and three sons, Ralph H., Jr., Richard K., and David D. Teed.

William Alfred Charles Thorpe (1880–1958), retired chief mechanical engineer, North Western Railway, London, England, died April 19, 1958. Born, London, England, July 24, 1880, son of Mr. and Mrs. Alfred West Thorpe. Education, King's College School and City & Guilds Central Technical College, London, England. Trained at Messrs. Yarrow & Co., Marine Engineers, London. Mem. ASME, 1920. Mr. Thorpe was decorated for service with the electrical engineers in the South African War in 1901 and 1902. He had been with the Great Western Railway and in 1903 joined the service of the Indian State Railways. During the British Campaign in Mesopotamia, he was locomotive superintendent for the military railways and assistant director of railways. He was awarded the O. B. E. In 1919 and 1920, he was sent on a deputation for the Indian Government to the United States to study the use of pulverized coal for locomotives. Subsequently, he returned to India and was senior deputy and locomotive superintendent for the Madras and Southern Mahratta Railway Co. He was an associate member of the I. Mech. E., a member of the Institute of Transport, and a member of the Institute of Locomotive Engineers. Survived by his widow, Mrs. U. Peffie Thorpe.

Joseph M. Towne (1875–1958), president National Blank Book Co., Holyoke, Mass., died April 12, 1958. Born, East Orange, N. J., July 7, 1875. Education, BS(ME), Stevens Institute of Technology, 1897. Mem. ASME, 1918. Mr. Towne joined the National Blank Book Company in 1912. He had taken out over a dozen patents on his own inventions and had full charge of prosecuting many other applications.

Curtis Warren (1926–1958), general engineering superintendent, Nuclear Fuel Division, Olin Mathieson Chemical Corp., New Haven, Conn., died April 6, 1958, in an airplane crash. Born, Scioto County, Ohio, Nov. 16, 1926. Education, BS(CE), University of Wisconsin, 1948; PHD, 1952. Mem. ASME, 1957. Mr. Warren had taught undergraduate applied mechanics at the University of Wisconsin before joining the General Electric Co., Richland, Wash. Later, he joined Goodyear Atomics Corp., Portsmouth, Ohio, and in 1956 went with Olin Mathieson. Survived by his widow.



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Better Designed

Behind this Erie City "FT" package unit is the manufacturing skill and engineering know-how acquired through more than a century of producing large, high pressure, water tube and fire tube industrial power boilers.

The "FT" has five full square feet of heating surface (ASME basis) per developed horsepower. The 3-pass design places the gas vent at the rear where it belongs. Carefully proportioned gas areas through three lengths of the boiler take into consideration reduced gas volume as heat is being rapidly absorbed by the surrounding water. The "FT" is a pressurized unit using forced draft to provide precise control of excess air and CO_2 — no leakage of outside air into the combustion chamber is going to lower the efficiency.

Better Built

The same modern shop practices and quality workmanship used on our largest power boilers are used on these package fire tube steam generators. Every "FT" is of welded construction, stress relieved and X-rayed as part of the quality built into this unit. The "FT" is built for easy installation and complete accessibility. A full length, rigid, all welded structural steel base carries the entire package unit, permitting quick and easy installation anywhere without the use of skids and without excavation or foundation work. The front and rear heads are constructed of insulated, sectional panels for complete accessibility to the tubes and combustion chambers.

Every Erie City "FT" is built to highest quality — not down to a price.

Better Serviced

Every "FT" is designed, built, assembled, piped, wired and *Factory Fire Tested* by Erie City Iron Works. A complete package steam generator ready to go to work when it reaches the customer's plant.

A *factory trained* Erie City field service engineer will supervise the initial start-up and will instruct the operating personnel in the proper operation of the unit. This feature of using *factory trained* service engineers plus *Factory Fire Testing* results in a correctly adjusted, efficient steam generator.

Investigate all the advantages of the Erie City "FT" package fire tube. Catalog literature is available and an Erie City District Sales Agent will be pleased to show you an "FT" in operation.

For the quality fire tube package "FT"— write for Catalog 5684-I

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STEAM GENERATORS • SUPERHEATERS • ECONOMIZERS • AIR PREHEATERS • WASTE HEAT BOILERS
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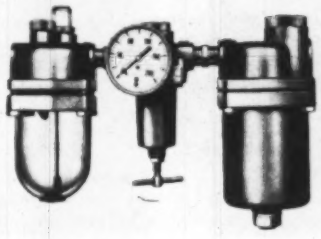


Air Line Controls

Tri-Duty air line controls providing clean, dry, well-regulated and properly lubricated air for use on all air-operated equipment such as air tools, cylinders, motors, clutches, chucks, have been announced by the Alemite Div. of Stewart-Warner Corp.

Consisting of an air line lubricator, water separator and air regulator, the package is specifically designed for extensive service life and peak efficiency under the most adverse operating conditions, the company states. The controls operate most efficiently and with a minimum of pressure drop at flows of 5 to 50 cfm and pressures up to 125 psi.

The heart of the package is the air line lubricator featuring a self-compensating valve said to eliminate the need for manual adjustment to accommodate varying air pressures and volumes. A second feature is the concentric venturi design. The oil venturi admits the oil directly to the center of the air venturi, in correct, measured quantity, providing a most uniform particle size for long-line distribution with little drop out.

Paper Thermometers

Paper Thermometer Co. announces that its Thermopaper and Thermotube disposable paper temperature indicators are now available for 100, 105, and 110 F to supplement the previously offered range of 115 through 490 F.

Measuring temperature by exhibiting an irreversible color change when subjected to a predetermined temperatures, they respond in less than a tenth of a second with an accuracy of 1 per cent, the firm states. A brochure listing prices, temperatures, and uses is available.

Line pH Meter

A compact new line-operated pH meter for fast continuous service field and laboratory applications is now available from Hagan Chemicals & Controls, Inc.

The electronic unit measures $5\frac{1}{2} \times 6\frac{1}{4} \times 2$ in., and is said to be ideal for accurate determination of pH in raw, untreated, treated, potable, cooling, and waste waters, boiler condensates and feed waters, and oil field blends and brines.

An auxiliary pointer permits checking of standardization without need of buffer solutions between measurements. Three minutes after being plugged onto a regular 100-125 v, 50-60 cycle a-c circuit, the meter is ready for operation.

The firm says, the meter covers a broad range of pH with high sensitivity. Color, turbidity or chlorine in test samples will not affect readings.

Self-Lubricating Motors

Franklin Electric Co. announces a line of electric motors incorporating reservoirs and feed devices designed to admit oil to sleeve bearings in controlled quantity after the original bearing lubricant is expended.

A supply of the proper type lubricant is contained in visual reservoirs mounted on each motor end bell, the firm explains. Oil is retained in each reservoir by means of a mechanical stopper, permitting normal handling prior to installation without loss of lubricant from reservoir, and eliminating lubricant loss due to prolonged shelf life.

After installation and at a predetermined length of operation time the lubricant is discharged to the bearing cavity. This is accomplished through the use of a wear-stem of controlled-density carbon which rides the motor shaft and begins to wear after a predetermined length of time.

The wearing of the stem triggers a spring action release of the mechanical stopper in the oil reservoir, allowing lubricant to enter the bearing wick cavity to supply the proper amount of lubrication. Oil is admitted only to a level required to feed the bearing, the company reports. Level is controlled by a built-in oil-level control tube. As oil is used from the wick cavity, it is continually replaced by fresh oil from the reservoir assuring a proper amount of lubricant to the bearing.

The new motors are available as standard in $\frac{1}{3}$ to $1\frac{1}{2}$ hp ratings in 56-frame construction, dripproof, open or totally enclosed construction, sleeve bearing equipped, and with or without capacitor.

Flexible Couplings

A standard line of miniature flexible couplings has been developed by Bridgeport Thermostat Div., Robertshaw-Fulton Controls Co., for use in close-tolerance applications.

Six different sizes comprising the complete line have been designed to eliminate all backlash and transmit uniform angular velocity at high speeds. The flexible couplings are available in phosphor bronze and beryllium copper.

A hydraulically formed seamless metal bellows is employed as the heart of the flexible couplings to reduce bearing wear and excessive friction caused by misalignment of shafts. The flexible couplings also may be used effectively to dampen vibrations, the firm states.

Shaft sizes range from $\frac{1}{8}$ to $\frac{5}{16}$ in. Overall lengths vary from $\frac{57}{64}$ to $1\frac{3}{32}$ in. Bellows and heads are delivered electro tin-plated.

Water Level Gages

Remote reading water level gages made by Reliance Gauge Column Co. under the name of Eye-Hye have been redesigned, in higher pressure models, for wider vision.

The firm reports that the image of the distinctive green indicating fluid is carried out in front of the face plate by means of a protruding plastic reading medium enabling boiler room attendants to read the water level at any angle, even 90 deg from center, either side.

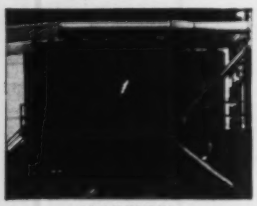
Construction has been improved to include a new high power illuminator. Models for pressures to 900 psi and 1500 and to 3000 psi are available.

from coast to coast...

Norblo

Automatic Dust and Fume Collection delivers dependable heavy duty service at low cost

CALIFORNIA



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Of all the major types of dust and fume collection systems, the modern automatic bag type process as developed by The Northern Blower Company is the most widely useful and adaptable. Its use in important large scale production processes extends from coast to coast, and to foreign lands.

Norblo's experience in the removal of injurious or "nuisance" industrial air contaminants as well as salvaging valuable materials has been extensive in most industries. Complete systems are engineered to specific situations. Equipment can be supplied for intermittent use or for 'round-the-clock full capacity requirements. Fully coordinated functional design results in high efficiency, low cost of operation and maintenance.

Norblo engineers the complete installation with ample capacity for your needs, with wide adjustability and all the safeguards you may need. It will pay you to have Norblo engineers study your requirements. Write for Bulletin 164.

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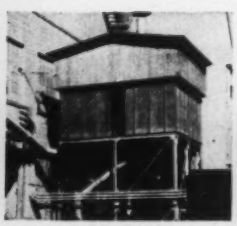
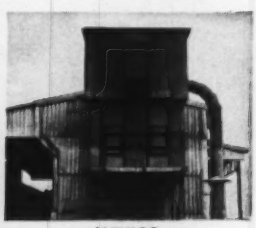


NEW YORK



MEXICO

Norblo ENGINEERED DUST COLLECTION SYSTEMS FOR ALL INDUSTRIES

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Lapping Machines

A new LP-4 vibratory lapping machine, employing controlled electromagnetic vibration for lapping of metal parts as large as 35 in. in diameter and weighing more than 75 lb, is announced by Syntron Co.

The unit's drive produces 3600 amplitude and frequency regulated vibrations per minute from 60 cycle alternating current passed through a half wave selenium rectifier in its separate control box.

This vibration produces a vertical movement which is coordinated with a radial movement by means of a tuned leaf spring system, the firm states. The result is a combined rotary and forward movement of the parts over an abrasive cloth in the lapping machine's pan.

Expansion Joints

Three models of packless expansion joints designed to absorb expansion and contraction in pipelines are being offered by Fulton Sylphon Div., Robertshaw-Fulton Controls Co.

The new models meet requirements in high and low pressure applications and in situations where corrosive materials are being transported, the firm reports.

All models, the company says, are available at lower prices than comparable expansion joints.

Model 1290 is suitable for use in steam and hot water lines under low pressure. The unit contains a special fiber packing material for double protections, and is recommended by the company for commercial and domestic baseboard heating applications.

Model 1291, equipped with a stainless steel bellows, has a working pressure of 150 psi and therefore better for use in higher pressure lines.

Model 12139-R is made entirely of stainless steel. All parts are electrically welded to form a continuous all-metal unit. It is rated at a maximum operating temperature of 1000 F and maximum operating pressure of 700 psig. Applications for this unit have been found in chemical and other industrial processing plants.

Selector Valve

A four-way selector valve, Model P1-418, designed to provide five primary advantages when it is used with chromatographic, other gas analyzer circuits or precision test systems is announced by Circle Seal Products Co.

The valve is said to eliminate leakage out of the valve body and prevent cross-port leakage. The four-port plug valve is designed to connect adjacent ports alternately by 90-deg rotation of the handle. Resilient O-rings are fitted into specially machined grooves to give the valve its leakproof characteristic.

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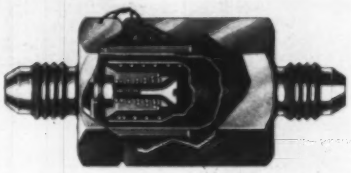


Servo Filter

Aero Supply Mfg. Co. announces a 45 μ filter designed for high pressure and high temperatures.

The operating pressure is 1000 psi; filter can be designed for pressures to 4000 psi. All components of the unit are suitable for high temperature exposure; this unit is designed for temperatures from −65 to +350 F ambient; −65 to 250 F fuel.

It can be designed for temperatures to 700 F, for fuels JP4 and JP5.

Drawing Board Balances

Frederick Post Co. announces a counter balance attachment for parallel ruling units, designed to hold a straight-edge firmly on a parallel ruling unit at any fixed position at board angles from near-horizontal to full vertical.

The firm states that two counter-balance assemblies, one right-side and one left-side assembly, are required to support the weight of the straight-edge properly. Each assembly consists of a constant tension device mounted at the top edge of the drawing board, plus a metal hook-bracket for mounting on the straight-edge. When the board is depressed to horizontal or near-horizontal angles, less tension is required and use of only one assembly is needed.

Attachments for each side are available in three pull-strengths of 11, 14, and 17 oz.

Torque-Free Bearings

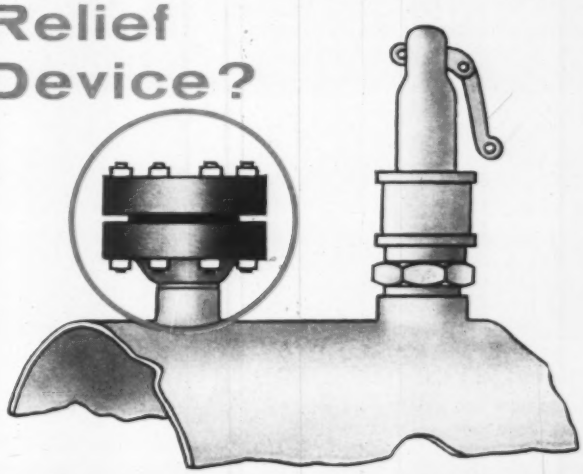
An electromagnetically powered ball bearing assembly is now available to precision instrument builders for special applications where vittually torque-free performance is required, Barden Corp. announces.

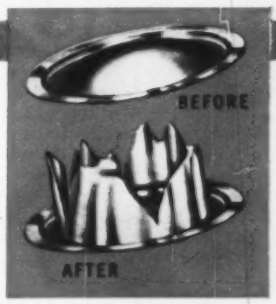
The firm says that in repeated laboratory tests, its bearings of .1875 in. bore have consistantly shown starting torque equal to running torque, with both below 25 dynecentimeters. Endurance tests showed no increase in torque after 1000 hr of operation.

In operation, an electromagnetic device oscillates the outer ring of the supporting bearings. This action tends to cancel out the friction torque resisting the rotation of the supported member.

Indicated applications for the bearing are gyro gimbals, scales, static balancing machines, gyro-stabilized platforms or other precision devices, the company states. Maximum benefits are derived at velocities approaching zero.

Why The "Standby" Relief Device?





The BS&B *Safety Head* Takes Over Under Abnormal Conditions

Your relief valve may need a helping hand.
The double protection provided by this relief valve – BS&B Safety Head combination is ideal when—

- **The nature of the pressurized fluid may cause malfunction of relief valve.**
- **Instantaneous over-pressure occurs due to abnormal heat or regulating conditions.**

When pressure-relief requirement is greater than the discharge capacity of the valve, the BS&B Safety Head provides an instantaneous, unrestricted opening.

Thousands of pressure systems are now protected with the added security of BS&B Safety Heads.

BS&B Engineers will be glad to evaluate your pressure system for application of the correct BS&B Safety Head.

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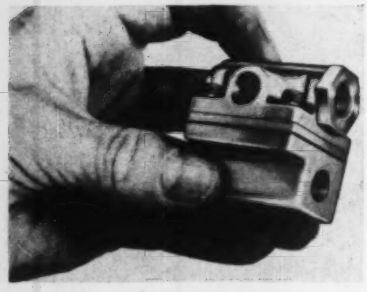

New 4-way Midget Valve

Mead Specialties Co., announces a new 4-way midget valve which can be remote-controlled by connecting the miniature limit valves through 1/4 in. plastic hose.

The units can be placed at some distance from the main valve, to be tripped by a working machine, tool, and operator's finger, pneumatic timer, the firm reports.

Known as No. 420, the valve is said to be surprisingly fast for its 1/8 in. apertures. A light, momentary touch releases air at one side of the valve piston, shifting the piston to that side, opening one part and closing the other. There is no neutral position.

Because of their compact size, these valves can be mounted in tight corners or inaccessible spots, but the controlling limit valves can be placed within easy reach, the firm states. Valve bodies are die-cast, fittings are brass, replaceable wear plate of special formula hardened noncorrosive metal.

Rotary Compressors

A new line of positive-displacement rotary compressors said to rival the efficiency and stability of reciprocating machines while matching the compactness and low maintenance of centrifugals has been announced by Fairbanks, Morse & Co. It is claimed to be the first of its kind to be produced in the United States for general purpose applications.

The new compressor is designed for continuous heavy-duty industrial service handling air, gas, or vapor with a standard capacity range of 800 to 13,000 cfm.

The compressor is a two-impeller, helical-lobe type, axial-flow, rotary machine with four-lobe power impeller and a secondary impeller with six matching gaps synchronized by timing gears. The impellers rotate with a pure rolling motion and power is transmitted to the secondary impeller through the cushion of compressed gas. The firm says there is never any metal-to-metal contact between impellers or with the surrounding casing and no lubricant contamination of the product.

Use a CLASSIFIED ADVERTISEMENT
For Quick Results

Fluid Drives, Couplings

An expanded line of Flexidyne dry fluid drives and couplings ranging in capacity from 1/4 to 1000 hp is announced by Dodge Mfg. Corp.

Added to the line are three larger sizes and a new small size for low horsepower applications. An 18-in. diam unit is now available either as a drive for use with V-belts, or as a coupling for direct shaft-to-shaft connection. Either will deliver up to 200 hp at 1200 rpm. Next larger size is the 22CK, available only as a coupling and capable of transmitting up to 800 hp at 1200 rpm. Largest of the new units is a 27-in. coupling, 27CK, with a horsepower rating of up to 1000 at 900 rpm.

For medium light applications such as cranes, fans, and small conveyors, the manufacturer has added a 6-in. unit. This one, available as a coupling or for use with V-belt drives, is rated at up to 2 hp at 1800 rpm. This and a 5-in. unit were designed for light duty low-cost drives.

Float Traps

A new line of float traps has been developed by V. D. Anderson Co., with increased capacities for draining condensate or moisture from steam, air, and gas equipment.

The continuous flow type traps are recommended by the firm for draining condensate from steam equipment continuously, and automatically, such as ahead of condensate meters where intermittently discharging bucket and thermostatic type traps cause irratic recordings. This continuous flow feature is also said to be desirable for draining moisture from all types of air and gas purifiers, separators, receivers, tanks, and other similar types of equipment.

Capacity of the traps ranges as high as 32000 lb of water per hour depending upon the differential pressure. The head and body are made of cast semi-steel and the valve and seat of Anderloy, a special corrosion resistant nickel alloy developed by the firm. All other internal parts are made of stainless steel or bronze. The traps are designed for a maximum steam operating pressure of 250 lb.

Lubricator Alarm System

A low-level and shaft rotation alarm has been designed by Manzel Div., Houdaille Industries, Inc., for use on its force-feed lubricators.

Purpose of the device is to shut down the compressor in the event the lubricator stops rotating and/or the oil level drops in the reservoir. The unit consists of a small pump, a bleed down chamber and a pressure switch which is actuated by the pressure in the bleed down chamber. The firm says that as long as pressure is maintained, an uninterrupted signal is furnished by the pressure switch. If the pump should not receive oil or the cam shaft stop rotating, the signal is interrupted.

KEY ENGINEERING OPENINGS AT VOUGHT

PROPULSION

Additional skilled engineers are needed: for existing projects and studies; for advanced propulsion and thermodynamic concepts. Current Vought projects include:

- **Crusader fighter series**
- **Regulus missiles • Dyna-Soar**
- **High-altitude Escape Capsules**

The technical areas include the fluid mechanics and heat transfer aspects of supersonic and hypersonic flow, propulsive systems (air breathing, rockets, nuclear, ionic), high temperature and cryogenic equipment. Following are 3 key openings:

Aero-thermo Specialist. M. E., or A. E., advanced degree, plus 7 or more years in internal aero and heat transfer. To lead complete analyses of this phase of propulsion systems.

Analytical Design and Development Engineer. M. E., or A. E., advanced degree, for work on environmental conditioning or auxiliary power sources and equipment.

Staff Engineer. Advanced degree (Ph.D. preferred) specialized in aero-thermo engineering or physics, plus 5 years applicable to aircraft nuclear propulsion or other advanced propulsive concept. Must be capable of handling the technical phases of the design work on these systems.

To arrange for a personal interview, or for a prompt report on these or other current openings, return coupon to:

C. A. Besio
Supervisor, Engineering Personnel
CHANCE VOUGHT AIRCRAFT, Dept. T-4
Dallas, Texas

I am a _____ Engineer,
interested in the opening for _____
Name _____
Address _____
City _____ State _____

Vought Vocabulary

ac′cu·ra·cy: *guided all the way, this long-range missile pinpoints distant, hard-to-hit targets*

This nuclear-armed "bird" is the supersonic missile with which the U.S. can retaliate against the toughest of enemy targets – distant, hard-to-hit military fortifications.

Chance Vought's *Regulus II* provides the extra margin of accuracy that enables the Navy to zero in on such "small" – and deadly – strongholds as H-bomb storehouses, submarine pens, ballistic missile bases.

The instant *Regulus II* launches, its advanced guidance system takes control . . . constantly compensating, correcting . . . keeping this Mach 2 missile on target to the instant of impact.

In production now, *Regulus II* provides double deterrence: the power to help forestall nuclear war – pinpoint accuracy to deter localized trouble.

Scientists and engineers: pioneer with Vought in new missile, manned aircraft, and electronics programs. For details on select openings write to: C. A. Besio, Supervisor, Engineering Personnel, Dept. T-4.

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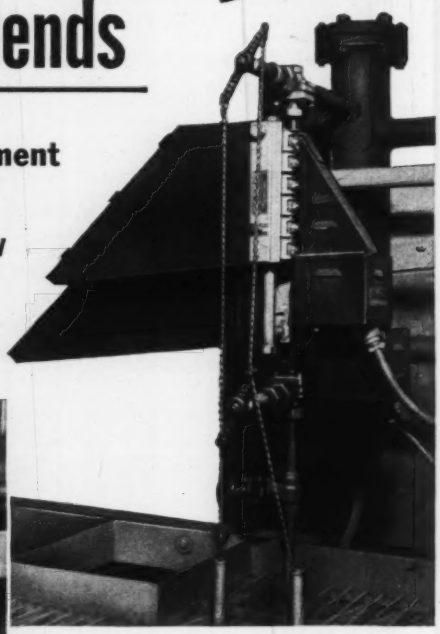
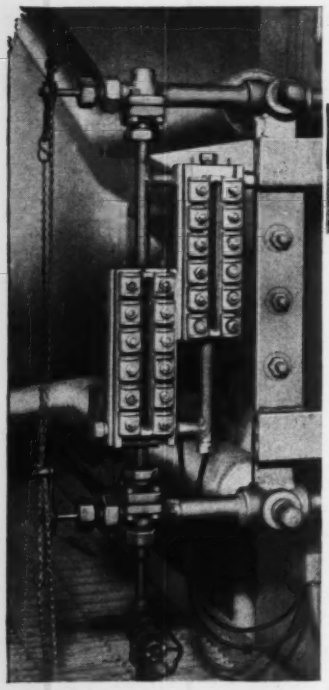
Boiler Water Level Security Pays Dividends

... Reliance Equipment insures safe, sure supervision for low or high pressure plants





"Two water gages on all boilers operating at over 400 psi" says the code. Here's an example, in the municipal light and power plant of Coffeyville, Kans., illustrating modern Reliance 900 psi equipment.

Water column includes whistle alarm; is equipped with flat glass gage insert, periscope hoods to reflect image through cat-walk opening to a floor-stand mirror below; and mercury lamp illuminator for sharp, brilliant projection. The second gage, also of double-window flat glass construction, is custom-made with tie-bar, for direct-to-drum installation.

Reliance builds for all pressures — brings you a complete line of boiler safety devices. The long record of efficient, dependable service — the extra margin of safety built into all Reliance Equipment — assures long life and low maintenance. Check with your consultants or ask for nearest Reliance Representative address.

The Reliance Gauge Column Co.
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The name that introduced safety water columns.... in 1884

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BOILER SAFETY DEVICES

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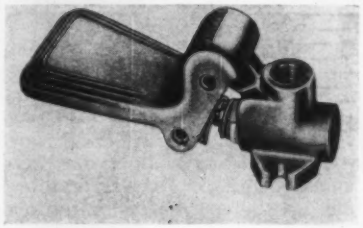


Foot-Operated Valves

Two and three-way poppet type valves that are actuated by foot pedal with only light action, have been introduced by A. Schrader's Son Div., Scovill Mfg. Co.

The surface mounted valves are packed complete with the foot pedal. Spring action closes the valves on release of the pedal.

Parts are positioned at right angles in the rugged brass body with heavy lugs for two bolt mountings in a convenient position for easy foot operation.

The No. 3476 two-way foot-operated valve, with air flow capacity of 75 cu ft (based on cubic feet of free air per minute at 100 psi inlet pressure), has $^3/_8$ in. NPT parts, designed for use where limited space is a factor. All parts are made of corrosion resistant material and are readily accessible for servicing.

Permanent Magnet Drum

A new permanent magnet drum is the latest development in a line of high-efficiency tramp iron separators using Indox V ceramic magnets manufactured by Stearns Magnetic Products. The new drum separator is designed for installation in any enclosed chute or spout conveying system. Indox V is an oriented barium ferrite material with an extremely high energy product, the company states. The magnets possess light weight, high electrical resistivity, great resistance to demagnetization and are made of inexpensive, noncritical raw materials. They are claimed to have an energy product over three times that of ordinary ceramic magnets.

In the new separator, a revolving stainless steel cylinder inside a welded steel housing carries material over a stationary magnet assembly. Tramp iron particles are picked up and rejected continuously and automatically, with no interruption of the material flow.

Rust Preventive

Lehigh Chemical Co. announces production of a nonflammable, nontoxic rust preventive for industrial use.

Packaged in a 16-oz aerosol container, Anderol L-536 rust preventive is designed to give protection from rust for all types of metal products and machinery.

Spray application provides a continuous light film protection that, in most cases, does not have to be removed before use or final finishing, the firm says.

KEEP INFORMED

BUSINESS NOTES
NEW EQUIPMENT
LATEST CATALOGS

Hydraulic Cylinder

A new Powrdraulic hydraulic cylinder line introduced by Hanna Engineering Wks. features a pressure tightening tube seal located on the outside diameter of the tube and is fully confined between the tube and cylinder head.

Because the seal is on the tube OD minute expansion of the tube under pressure squeezes the O-ring increasing the tightness of the seal, the company explains. Unlike tubes that seal at the ends or inside diameter, the new seal will remain tight at all pressures, it is stated.

The cylinders are rated at 2000 to 3000 psi non-shock. Bore sizes range from $1^1/_2$ through 8 in. in 13 basic models and a choice of rod sizes. The cylinders have industry standard mounting dimensions and conform to JIC recommendations.

Cryogenic Pumps

Four lines of standardized pumps for handling cryogenic liquids have been announced by Byron Jackson Pumps, Inc., Subsidiary of Borg-Warner Corp.

The pumps are designed for pumping liquid oxygen, nitrogen, methane, and other sub-zero fluids to −320 F and below.

The four standardized lines—the SM Process, VMT, Hydropress and Bilton pumps—are adaptations of the firm's process pumps.

Adaptation of the designs was made possible by development of a reliable, economical mechanical seal for very low temperature liquids. Though a sharp variation from conventional seal design, it is claimed that the new Lo-Temp mechanical seal is as easy to maintain and operates as effectively as a standard seal.

Industrial Transmission

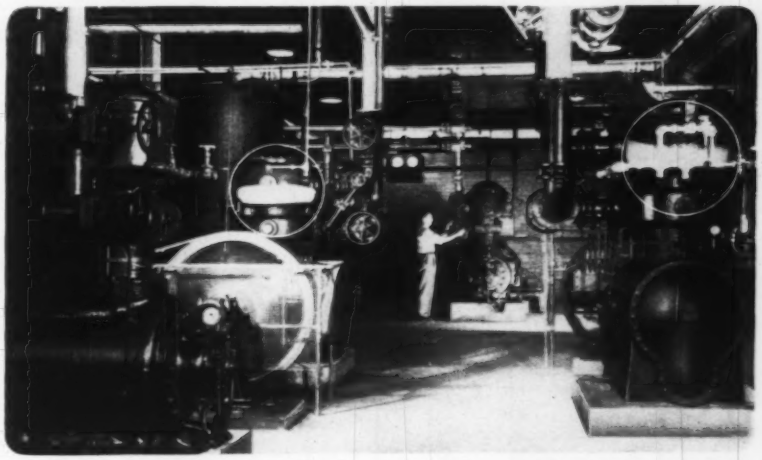
Borg-Warner Corp., Warner Gear Div., has developed a heavy-duty industrial transmission for use on lift trucks, front-end loaders, and other materials handling equipment.

Designed for use with either gasoline or diesel engines, the new transmissions are said to combine the most desirable features of the torque converter and the fluid coupling with the added advantage of power shifting in one or two speeds for forward and reversing operations. Heavy torque requirements, such as knifing under loads, starting on ramps, or towing and pushing, are obtained with torque converters driving through low or high speed transmission gears.

Because of hydraulic shifting there are no gear-shifting delays and the operator has finger-tip touch control for fast, smooth change of direction, the company reports. Constant mesh prevents clashing of gears which would cause undue wear or damage to these components.

Available in four different models, the new units require no clutch band adjustments and are equipped with a simple, dependable valve body.

LOOK AT THOSE FROSTED JACKETS

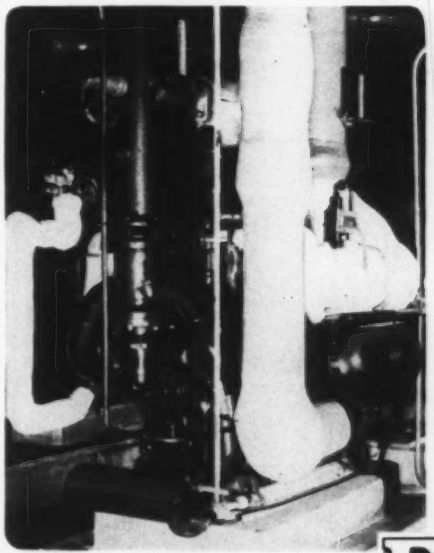


Two of five Frick booster compressors on a large low-temperature operation. All have cylinders cooled with direct-expansion ammonia. (Frick Patent No. 2,553,623)

They're a patented feature of Frick booster compressors . . . whereby the jackets are cooled with direct-expansion refrigerant.

These frosted jackets remove a tremendous amount of heat from the discharge of the compressor, and make the entire two-stage system operate with much higher efficiency.

Refrigerated jackets permit the cylinders to fill more completely, increasing the volume of gas pumped; they make the valves run cooler and causes lower compression temperatures. Better lubrication of valves and pistons results. The outlet connections from the jackets are carried to the suction of the second-stage machines.



Note the ammonia connections to cylinder jackets on this "ECLIPSE" booster, running at 1200 r.p.m., supplying low-temperature service.

Jackets cooled with refrigerant are much colder than those fed with water: also, the danger of freezing the water is avoided.

This highly efficient cooling system can be applied to staged refrigerating systems of any design, with any type compression equipment, using any refrigerant. It is protected by Frick Patent No. 2,553,623. The lower the temperature, the greater the savings—up to 20 per cent at minus 80 degrees. When you buy low-temperature refrigeration, insist on this important feature.

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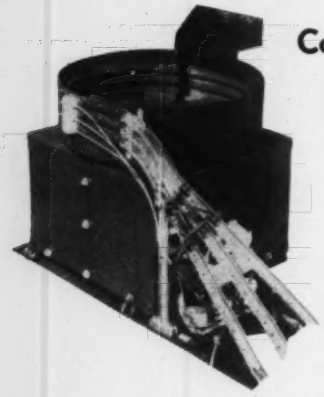

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Gear Pumps

A new line of variable displacement gear pumps that contain only two major moving parts and feature automatic pressure compensation is now available from Pesco Products Div., Borg-Warner Corp.

Designated the VIEP, the new pump has been designed especially for use in airborne hydraulic systems, but is also applicable in industrial machinery and equipment, the firm reports.

The low-cost positive displacement units are said to provide the reliability and simplicity of a gear pump combined with efficiency comparable to a variable displacement piston pump. They are particularly applicable to high-speed, elevated temperature operations, the company says.

The main pumping elements of the unit consist of an internal ring gear and pinion. An integral pressure-sensing device provides automatic pressure compensation, adjusting pump displacement to meet variations in system delivery requirements. Adjustment for variation in pump delivery is accomplished with a simple linear motion. External linkage for manual or automatic remote control of pump displacement can be provided.

Gear set alignment is maintained independent of hydraulic loads or thermal conditions. The fluid flow path through the new pump is designed to insure smooth discharge flow at all displacements. A 270-deg inlet area provides more positive filling—eliminates inlet pressurization at speeds up to 24,000 rpm.

Flange Ball Bearing Mount

A new flange cartridge ball bearing mount introduced by Fafnir Bearing Co., has a housing flange with two bolts instead of the standard four.

The bearing's wide inner ring is self-aligning in any position, and it will accommodate shaft diameters ranging from $1/2$ to $1^{15}/_{16}$ in. the company states. Bolt spacing is dimensionally the same as the diagonal distance between bolt holes in the standard four-hole type. Made of cast iron, the new ball bearing mount is adequate for heavy-duty service. It is completely assembled and ready for installation.

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Molded Nylon Screws

An expanded line of close-tolerance molded nylon screws is available from Gries Reproducer Corp.

Now available are molded nylon machine screws, and headless set screws, stock sizes 4–40, 6–32, 8–32, 10–32, and 1/4–20. Lengths range from 1/4 to 1 in., with standard increments of 1/8 in., with special intermediate lengths also available.

The machine screws, first introduced with a standard binding head, are now offered also with round, fillister, and flat head, in Phillips or slotted types. All types except the flat head are also available with an integral washer molded beneath the head of the screw.

According to the company, the one-piece washer-head machine screws provide an effective seal under the head, eliminate a separate washer, and are suited for oversize or offset holes and adjustment slots.

The headless set screw is available with a variety of points—plain, cone, oval, flat, half-dog, and full-dog.

Temperature Probe

A positive means of providing a continuous record of furnace temperature conditions during boiler start up is claimed for a new traversing temperature probe developed by Copes-Vulcan Div., Blaw-Knox Co.

The new device travels back and forth through critical superheater or other furnace passes to indicate or record instantaneous temperatures while registering its position to guide the operator in his firing procedure.

An adaptation of a retractable soot blower, the probe consists of a thermocouple mounted on the end of the lance. Unlike the soot blower, the lance does not rotate as it traverses back and forth across the furnace area. The Chromel-Alumel thermocouple is suitable for temperatures up to 2200 F, and protective tips are available for either 1600 F or the higher temperature, the firm reports.

Relief Valves

Fluid Controls, Inc. has announced a differential piston type relief valve available in four pressure ranges.

Formerly built for two ranges, the new models are now produced in four pressure ranges–100 to 800 psi; 250 to 1500 psi; 1000 to 3000 psi; 1500 to 5000 psi. All four ranges are available in 1/4, 3/8, 1/2, 3/4 and 1 in.

In the differential piston valve design, the pressure acts on the annular area between the OD and the reduced diameter of the piston. When the pressure acting on this area is equal to the spring force, the valve opens. Effective force of pressure is not reduced by the high velocity-low pressure conditions which occur ahead of the seat. The firm says they are adjustable and work efficiently at any pressure setting between the limits of the pressure range selected.

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New Tape Patterns

Chart-Pak, Inc. has announced the addition of six new patterns to its standard line of narrow Curve Line tapes.

The standard patterns are all available in combinations of black on white, red on white, blue on white, green on white, and black on transparent tape. A new folder shows sizes from $1/32$–$1/16$ in. wide by 648 in. long and $1/8$ – $1/4$ in. wide by 324 in. long.

Pipe Insulation

A new pipe insulation made of fine glass fibers with a full-length hinge action opening for easy installation is now being manufactured by the L.O.F. Glass Fibers Co.

The product is available with or without factory-applied canvas, vapor barrier, flame-retardant, waterproof or general purpose jackets. With a temperature range from below zero to 350 F, it can be used to insulate pipelines carrying hot or cold water, brine or low pressure steam, the firm reports.

High thermal efficiency of the new material is made possible by the uniform diameter of the fine-fibered glass, a direct result, according to the company, of the electronic-extrusion process developed by the firm.

The insulation comes in one-piece formed sections 3 ft in length and is available in inner diameters to fit standard iron pipe and copper tubing. It is offered in a range of wall thicknesses necessary for the simplified dimensional plan used by the industry for multiple layer application.

Vacuum, Pressure Pump

Lear-Romec Div., Lear, Inc., announces a combination vacuum and pressure pump designed primarily for pre-flight testing of missile instruments such as Mach meters.

The firm says the unit can be adapted for other forms of ground support equipment; it can be supplied with a varied group of pressure switches, check valves, relief valves, air dehydrators and other accessories.

The unit consists of a vane type dry air pressure pump and an oil wetted rotary vane type vacuum pump, mounted at opposite ends of an electric drive motor. The unit is complete with starting capacitor and relay.

The oiler, which uses silicone oil as the wetting agent for the vacuum pump, can be positioned to allow the complete unit to be mounted in any position from 0 to 90 deg. The unit will operate satisfactorily in ambient temperatures ranging from −65 to +130F, the company states.

The pressure pump will deliver 400 cipm of free air at 30 psig or the unit can be furnished with a piston pump for pressures up to 65 psig. The vacuum pump has an ultimate vacuum of 0.20 in. Hg absolute or 1200 cipm free flow with no vacuum. The electric motor is $1/4$ hp at 3450 rpm, 110 v a-c. A 400-cycle motor is also available.

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Coupling Preamplifier

Sanborn Co., Industrial Div., announces its Model 450-1300 d-c coupling preamplifier, one of a new series of unit preamplifiers designed for use with optical oscillographs, tape recorders, oscilloscopes, and other indicating devices.

It is described as a moderate gain, balanced input-balanced output d-c amplifier, which will perform equally well with single-ended or balanced signals. A three-stage circuit features cathode follower input and output, with over-all gain provided by the second stage push-pull transistor amplifier. Input is single-ended or push-pull, impedance 5 megohms each input side to ground; 50 mv input produces 1 v at output jack under maximum output load conditions.

Frequency response is 0-10 kc; linearity, 1/4 per cent. Plus or minus zero suppression, to 20 times full scale voltage, is included. Calibration is provided by a 100 mv internal signal. Front panel controls of the 450-1300 include sensitivity, position, attenuator, balance, Use-Off-Cal switch, zero suppression dial and in-out switch, and connectors for input and output. A model without zero suppression (450-1300A) is also available.

Steam Generator

An oil and/or gas fired, pressurized-furnace steam generator designed for power, process, or heating loads requiring steam capacities up to 400,000 lb per hour has been placed on the market by Babcock & Wilcox Co.

The company states the boiler offers an advanced design in "Membrane Wall," prefabricated furnace construction, which utilizes welded tubular furnace wall panels.

High efficiency and the elimination of the induced draft fan are said to be accomplished through the pressurized-furnace design, with a subsequent savings in fuel, fan, and power costs. Boiler operation is simplified because there is only one fan to operate and maintain. The design also eliminates the need for all internal closure refractory.

Designated the PFI, the unit is available for steam pressures up to 1150 psi, and for superheated steam temperatures up to 900 F.

Machine Support Bushing

A new, compact straight type roller bearing bushing for replacement of the bronze bushing in the outer support of horizontal milling machines where limited diameter requirements exist is announced by Donley Products, Inc.

The firm says the new design makes practical its use as an inboard support as well as an outboard support by minimizing the loss of work area due to minimum overhang.

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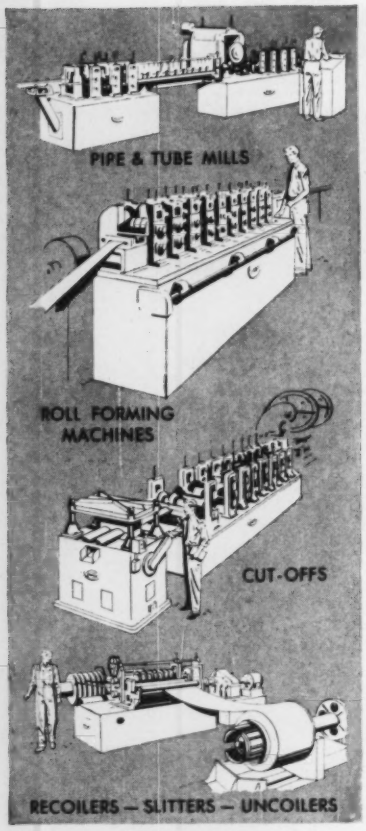

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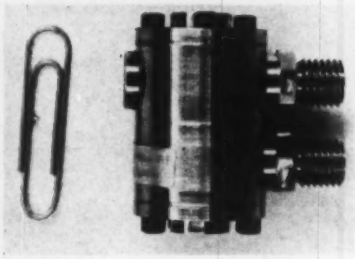

Pressure Transducer

A new type adjustable range pressure transducer has been developed by the Yuba Research & Dev. Center, Yuba Consolidated Industries, Inc.

The transducer is of the double-coil variable reluctance type and has a flat diaphragm as the pressure sensing element. It is for use in missiles, blast studies, industrial instrumentation, and other applications which require an instrument of small size with high response rates and resistance to severe environmental conditions. The unit translates gas or liquid pressure to proportional electrical signals used in recording or control systems.

The newly developed transducer, Model P-501, has pressure range adjustments by a factor of two or more and close sensitivity adjustments. Complete interchangeability of one transducer to another of any range, with constant output is claimed for the unit.

It has outputs of 0.3 v per volt over a carrier frequency range from 400 cps to 70 kc allowing operation of all standard telemetering channels. Terminals are sunken in the transducer for protection against breakage.

The instrument is $^{7}/_{8}$ in. in diameter and $1^{3}/_{8}$ in. long, including terminals and provision for mounting bracket. It weighs less than $2^{1}/_{4}$ oz.

High-Temperature Fasteners

Alloy steel fasteners with new diffused cadmium-nickel alloy plate for high-temperature service (AMS 2416) are now available from Huck Mfg. Co.

The firm says the new development permits use of standard fastener materials in elevated temperature applications, providing savings over so-called exotic materials which would otherwise be required.

Protection with diffused cadmium-nickel plate elevates the usable temperature limit for conventional SAE 4037 alloy steel Huckbolt fasteners to 900 F allowable. This compares with the standard 400 F allowable temperature for conventional aircraft cadmium plate. The fasteners with cadmium-nickel plate display at 900 F corrosion resistance equivalent to the 400 F performance of parts having conventional cadmium plate.

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Gas Boilers

A new line of WP boilers rated at 80, 100, and 125 hp are announced by Steam Boiler and High Temperature Heat Transfer Div., Eclipse Fuel Engineering Co.

All three boilers in the new line are normally equipped for gas firing but can be provided with an oil burner or with full combination gas/oil burner assemblies. Burners are provided for light fuel oils.

They are provided as packaged units, and are capable of producing continuously at rated capacity or better without adverse effect or strain on a 24-hr-per-day, seven-day-per-week basis, the firm states.

Impulse Steam Trap

A new impulse steam trap, engineered especially for light condensate load applications, has been announced by Yarnall-Waring Co.

The design of the new trap YARWAY No. 30 includes a lever-type valve, which pivots about a fulcrum, discharges air and condensate at full capacity at start-up time and snaps shut when steam reaches the trap, providing closer shut-off. The lever action also provides much quieter operation, the firm claims.

The unit has a replaceable valve-seat assembly, only one moving part and stainless steel construction.

Force Balance Transmitters

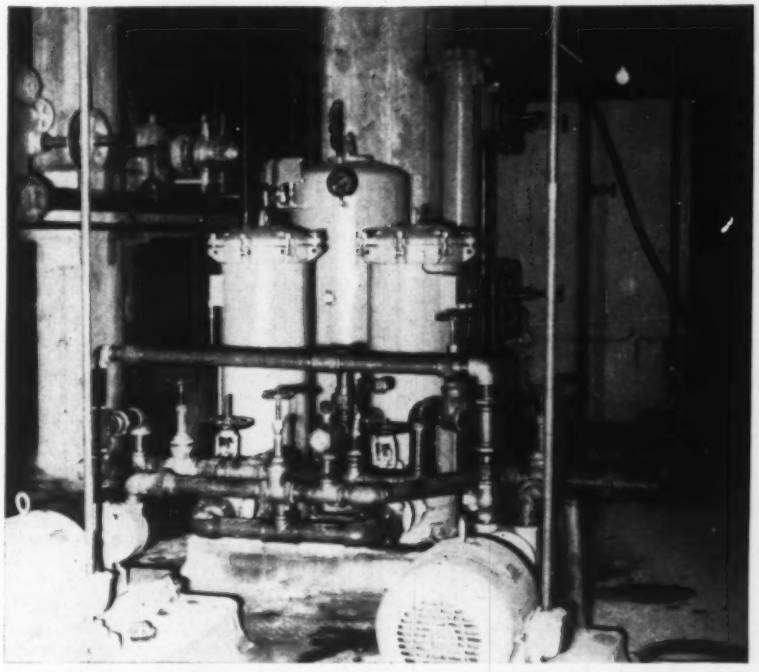
A new line of force balance transmitters which measure and pneumatically transmit flow, differential pressure, level and specific gravity, is now being manufactured by Bailey Meter Co.

Transmitters measure over a minimum range span of 0-2 in. H_2O under service pressures to 50 psig, to a maximum span of 0-2000 in. H_2O under service pressures to 5000 psig.

The firm says no viscous or other dampening devices are needed. Stability is maintained by a newly developed reset type booster relay.

When a pneumatic signal, varying linearly with rate-of-flow, is required for recording on the same chart with other linear quantities, or for integrating, and/or control purposes, the transmitter has a built-in square root extractor. The flow transmitter, which may be mounted directly on the process piping, is said to be particularly useful as one element of a multi-element control system. Its linear rate-of-flow signal combines easily with pneumatic signals from other linear transmitters, the firm reports.

Three standard measuring diaphragms provide all ranges. Ten to one differential range change is possible with simple screwdriver adjustment. Air consumption is 0.07 scfm at balance on dead end service. Standard SAMA transmitting signal ranges of 3-15 or 3-27 psig are utilized.



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Standard Notching Units

Wales-Strippit, Inc., a Unit of Houdaille Industries, Inc., has announced a new line of standard notching units for notching sheet materials up to a capacity of $^1/_8$ in. mild steel.

The units are available for rectangular or "V" edge notching, for radius notching, or in any irregular shapes within the physical limits of specific models, the company states.

Speed Reducers

A new line of helical-geared speed reducers, designed for adaptation to a variety of mounting positions, has been announced by Boston Gear Works.

The new Optimount series features a basic unit, with either single or double reduction helical gearing, which can be mounted directly on the driven shaft or mounted in standard stock horizontal or vertical bases. Four sizes of basic units provide output speeds of 10 to 431 rpm, and capacities of $^1/_6$ to 15 hp.

The basic units are available in three types: Reductors, designed for V-belt, sprocket or gear drive to input shaft; Ratiomotors, providing direct motor drive to input shaft; flanged Reductors, the Ratiomotor units sold without motor, ready for attaching motors of the user's choice.

Press-Fitting Machine

A new machine for simultaneously pressing all valve-guide bushings into engine cylinder heads has been developed by Gear-O-Mation Div., Michigan Tool Co. This hydraulically operated, electrically controlled machine press-fits valve-guide bushings at a pre-determined force into any one of a family of five different diesel-engine cylinder heads. The heads are for two, three and four cylinder engines of two types—in-line and V-type—with the three and four cylinder models having either two or four valves on each cylinder. The firm says the machine handles the valve-guide bushing insertion for the entire series. It also provides a visible and audible indication (signal light and bell) of any improperly positioned or loose fitting bushings.

According to the company, versatility of the new machine is gained from an interlocked electric and hydraulic circuit individually controlling four rams, in combination with easily changed ram guides. Normally, each ram will press-fit two bushings for each engine cylinder. The 'alternate' ram guides are used when it is desired to press-in four bushings per cylinder. The operation can also be variably controlled for either simultaneous or progressive pressing.

The machine is semi-automatic. The bushings are preliminarily finger positioned and the cylinder head is manually rolled into and manually rolled from the machine.

If ever there was a time for optimism — it's now! Here's what is coming . . .

1. More people . . . Four million babies yearly. U. S. population has *doubled* in the last 50 years! And our prosperity curve has always followed our population curve.

2. More jobs . . . Though employment in some areas has fallen off, there are *15 million* more jobs than in 1939—and there will be *22 million more* in 1975 than today.

3. More income . . . Family income after taxes is at an all-time high of $5300—is expected to pass $7000 by 1975.

4. More production . . . U. S. production *doubles* every 20 years. We will require millions more people to make, sell and distribute our products.

5. More savings . . . Individual savings are at highest level ever—*$340 billion*—a record amount available for spending.

6. More research . . . *$10 billion* spent each year will pay off in more jobs, better living, whole new industries.

7. More needs . . . We need *$500 billion* worth of schools, highways, homes, durable equipment. Meeting these needs will create new opportunities for everyone.

Add them up and you have the makings of another big upswing. Wise planners, builders and buyers will act *now* to get ready for it.

FREE! Send for this new 24-page illustrated booklet, "Your Great Future in a Growing America." Every American should know these facts. Drop a postcard today to: ADVERTISING COUNCIL, Box 30, Midtown Station, New York 18, N. Y.

(This space contributed as a public service by this magazine.)

KEEP INFORMED

BUSINESS NOTES
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Fractional HP Motors

Major changes in General Electric Form G fractional horsepower motors have been announced by the company.

Representing the first major changes made since the design was introduced, the features include plug-in quick-connects for all terminals, cutting wiring in half; quick change of rotation by simple reversal of the two plug-in motor leads; and brass links that simplify voltage change on dual-voltage motors.

An enlarged wiring compartment and a narrower terminal board permit fast hook-ups during installation, the company reports. An anti-rust treated shaft and bright-plated hardware for protection against corrosion, a built-in lug for convenient grounding connection and a composition washer in the centrifugal switch for quiet operation are other significant changes. A new bonding method is used for insulating the stator winding and metal clamps securely fasten the stator laminations for more uniform core alignment. Identification and maintenance data have been made highly legible for easy reading.

Variable Rate Feeder

Syntron Co. announces its new Model F-010 electromagnetic vibratory feeder for fast, high-capacity, rate-controlled feeding of bulk materials and small parts in weighing, blending, mixing, packaging operations.

The electromagnet drive produces 3600 smooth vibrations per minute. A rheostat control affords instantaneous adjustment of feed rates from a slow dribble flow, through continuously variable settings, to a maximum capacity of three tons per hour, the company reports.

Three-Pass Marine Boiler

A new design of Scotch marine boiler, said to provide high efficiency and operating economy, is announced by Titusville Iron Works.

The company states the new three-pass unit features a rear combustion chamber of unique water cooled design. This is said to eliminate the need for refractory in the rear combustion chamber. Complete wet back construction assures that hot gases are in constant contact with water cooled steel walls, utilizing to the maximum the useful heat of the gases, the firm reports.

The unit is manufactured in low pressure S3H series and high pressure S3P series in sizes from 1725 lb/hr of steam to 31,050 lb/hr of steam.

Boiler efficiency of the three-pass units (both gas and oil fired) exceeds 80 per cent. They are designed for light or heavy fuel oil and gas or combination oil and gas firing. They have heat release rates of less than 88,000 Btu per cu ft of furnace volume at maximum continuous output ratings.

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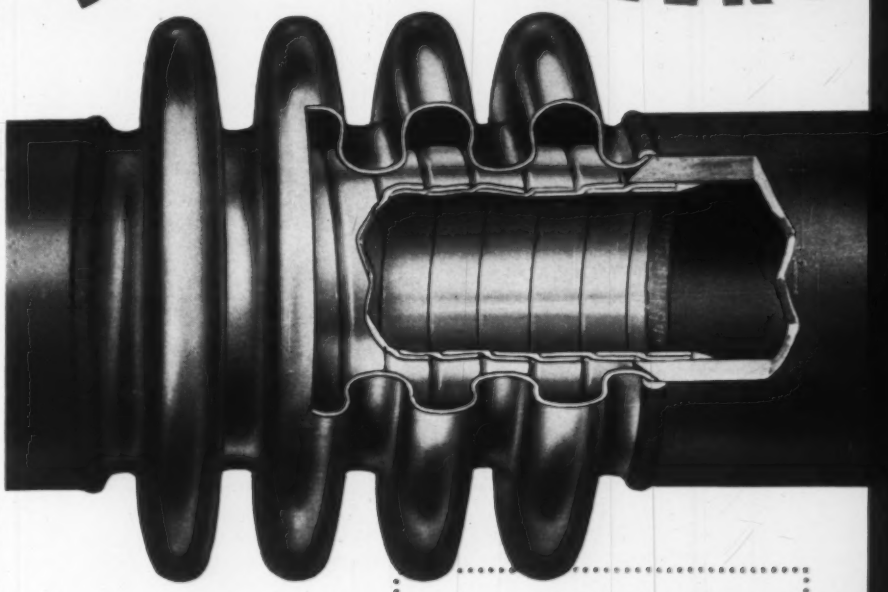
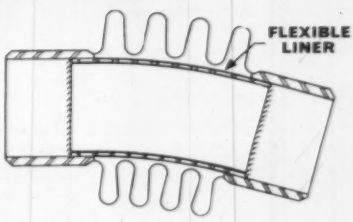
FLEXIBLE LINERS



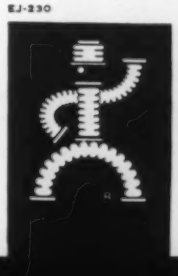


Lateral or angular motion without flow reduction of conical type liners

No more need to specify oversize expansion joints to allow for the flow reduction through an ordinary conical liner! Now you can get Flexon Expansion Joints with flexible liners that give full flow. Easier to install, too, because flow can be in either direction. A section of smooth interior, Flexon stainless steel hose forms the liner—cuts flow turbulence, reduces carrier temperature and permits full pipe movement either laterally, angularly, or axially. The cost is no more than for conical sheet liners.

Write today for facts about this new Flexon development—and your copy of the 28-page Flexon Expansion Joint Design Guide, the complete handbook for solving every problem in pipe motion.

EJ-230



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EXPANSION JOINTS · METAL HOSE · NON-METALLIC HOSE · BELLOWS · AIRCRAFT COMPONENTS

Using vertical polarized light on a cross-section of pipe, photographer Bernard Hoffman clearly shows the ravages of corrosive action.

Controlling Corrosion in Fluid Engineering

Corrosion seldom works alone. Together with heat, pressure and abrasion factors, it compounds the problems of fluid engineering. But when you have valve design problems involving corrosion, you can look to the engineering leadership available at S. Morgan Smith for assistance.

You can use R-S Rubber-lined Butterfly Valves, for instance, to handle many special applications. The rubber lining protects the entire valve body, gives you corrosion resistance with maximum economy. Where your processing problem demands additional engineering, you can draw on the broad SMS background of experience in specialized valve applications.

There is a complete SMS line – Rotovalves, R-S Butterfly Valves and Ball Valves – to meet your fluid control problems. To obtain full information, contact our nearest representative, or write S. Morgan Smith Company, York, Penna.

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AFFILIATE: S. MORGAN SMITH, CANADA, LIMITED, TORONTO

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Taper Face Flanges

New ratings broadening the service range of its lightweight forged steel taper face welding neck flanges have been announced by Tube Turns Div., Chemetron Corp.

On the basis of extensive fatigue and bending tests under simultaneous pressure, the flange is now recommended for 175 psi liquid, gas, or air service at 150 F. Originally the flange was rated at 125 psi WOW. It is now rated suitable for 125 psi dry saturated steam at 353 F.

The new ratings correspond with the steam rating of Class 125 cast iron or semi-steel valves, substantially increasing the range in which the flange can be used in steam service. The new data makes it possible to extend use of the firm's light weight taper face flange to heating, air conditioning, and general service piping installations, within the scope of these pressure ratings, the company reports.

Gas-Fired Unit Heaters

A new range of sizes in duct-type gas-fired unit heaters for commercial and industrial heating is now available from American-Standard, American Blower Div.

The new heaters are recommended by the company for automatic heating in forced-air duct-distribution systems.

The new units feature an advance design with side- mounted gas controls, which are suitable for connection to either side. They are furnished with low-voltage control and a 24-v transformer having a dual primary circuit suitable for either 115 or 230 v connection The new size range includes six models rated from 50,000 to 165,000 Btu per hr input, adding to previously established 205,000 and 230,000 Btu per hr input sizes.

Precision Plug Gages

A new development in threaded precision plug gages has been announced by Spence Industries.

Called Jo-Plugs, the new gages are said to simplify inspection and set-up procedures for checking the dimensional accuracy of threaded hole centers. The gage consists of a threaded plug base and an upper spindle. The spindles act as a constant throughout the entire range of plug sizes and are a uniform .200 in diam, the firm reports.

To check center distances, proper size plugs are screwed into the holes, allowing the spindle to act as reference measuring points. The checker then measures the distance between spindles, and adds the constant to obtain the distance between centers within a tolerance of ±.00015.

The plugs are made of hardened Graphmo tool steel and are precision ground. They are available in boxed sets in thread sizes ranging from No. 4 to 1 in., National fine or coarse thread or special thread forms.

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Aluminum Protective Coating

A new aluminum pigmented liquid coating that is loaded with potent rust inhibitors to provide long term protection against rust and corrosion under severe exposures in marine and industrial atmospheres has been developed by Gulf Oil Co.

The new product, Metalcoat-A, provided four years of satisfactory protection in a salt spray and marine atmosphere test at a commercial testing station, the firm reports. This is claimed to be the equivalent of seven to ten times greater protection than that afforded by similar products.

The product can be applied to either rough or polished surfaces and the surfaces do not have to be entirely rust-free. It is unaffected by temperature changes. In consistency, it is similar to heavily pigmented aluminum paint and can be applied by brush, roller, spray, or by dipping.

For most outdoor metal surfaces, it is recommended that two coats be used to provide lasting protection. A gallon will cover 250 to 300 sq ft.

High Pressure Filter

A new series of laminated fiber disk filters now being offered by Wm. W. Nugent & Co.

The new filters, designated as 1555CP, are designed for hydraulic and other high pressure applications. They are constructed for 3000 psi working pressure to comply with the requirements of the ASME Code for Unfired Pressure Vessels. API or ASME code inspection and stamping is available.

The filters are offered in five sizes with capacities ranging from 1.5 gpm at 3 psi pressure drop to 47.6 gpm at 6 psi pressure drop when filtering 100 SSU viscosity mineral oil. For larger capacities, the filters may be connected in multiple. Inlet, outlet, and drain are located in the bottom of the filter.

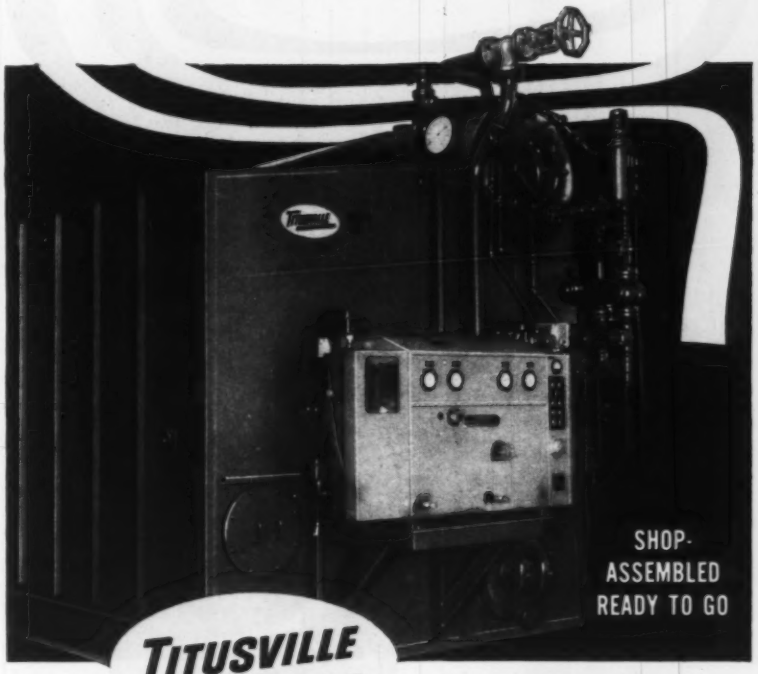
Centrifugal Extractor

A new centrifugal moisture extractor has been developed by Johnson-March Corp. for removing free moisture from wet scrubber exhausts.

Five sizes are available to handle a range of exhaust gases from 10 to 35,000 cfm. The new extractor changes the direction of exhaust gas flow from a vertical to a cyclonic path. Centrifugal action imparted by stationary impeller blades removes all free moisture along with some of the entrained dust or solid particles. Moisture impinges on the inside of the outer shell and collects at a drain outlet for disposal.

Cleaning and inspection of the all-welded steel extractor is facilitated by two, watertight, neoprene gasketed inspection doors and a backwash nozzle at the apex of the stack. The operator controlled spray both cleans the vanes and flushes the stack. The nozzles consume 45 gpm at 60 psi pressure during cleaning operations.

10,000 pounds
to 60,000 pounds
of quality
steam per hour



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TYPE WTP
PACKAGED STEAM GENERATOR

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The Titusville WTP Steam Generator's ease of installation and simplicity of operation are matched by the economy and dependability in operation that make this water-tube unit a standout in value year after year! Completely shop-assembled, requiring no special foundations, high stack or induced draft fan, the Titusville WTP is ready to serve you the moment service connections are made. *Let us discuss your needs.*

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Weatherproof A-C Motor

A new weatherproof a-c motor for use in applications where the motor is subjected to extreme moisture or the elements is now available from Reliance Electric and Engineering Co., in all standard speeds in sizes from one through 250 hp.

The new motor is an open motor that exceeds NEMA splash-proof requirements. All of its external parts are of corrosion-proof cast iron; shaft openings are sealed by a shaft cap and slinger.

The firm reports that the insulation system is completely non-hygroscopic. It features silicone sleeving, glass-mica slot liners and glass mat top-sticks and mid-sticks. The heavy formvar wire coils are repeatedly immersed in special thermosetting, oil-and-water-resistant varnish, then sealed with a final coat of special red finishing enamel.

The rotor OD and stator ID are coated with a rust inhibitor. A special nonwashing grease is used in the bearings, which meter in just the right amount of grease from the large reservoirs as needed, the company states.

The watertight conduit box is cast iron with a gasketed cover and threaded outlet. Zinc-plated, noncorrosive hex-head bolts are used throughout the weatherproof motor.

BUSINESS NOTES

New Transformer Plant

Westinghouse Electric Corp., has selected a site for a multimillion dollar power transformer plant in Muncie, Ind.

The proposed new plant will be a part of the Westinghouse transformer division and will add to the capacity of the division's main plant at Sharon for the manufacture of large power transformers. The new plant will be located on a 300-acre tract south of Muncie. Although no date has been set for the start of construction, it is expected that production will begin in late 1961 or early 1962. When normal operations are reached, the plant will employ more than 2000 persons.

West Coast Division

Illinois Tool Works, Chicago, has established a West Coast division which will be known as the Calinoy Div.

Office and plant facilities of the new division are located at 12917 Cerise Ave., Hawthorne, Calif., a suburb of Los Angeles. The division will function as West Coast headquarters for sales, engineering and manufacturing of metal and plastic fasteners designed and developed for special purpose applications in the missile and aviation industries.

International Subsidiary

Joy Mfg. Co. of Pittsburgh has announced the recent formation of Joy International, S.A., a wholly owned subsidiary. This move was made according to the company, to better promote Joy's extensive overseas sales, service, and production activities.

Among the purposes of the new international company are the development of sales of products throughout foreign markets, the rendering of technical advice and service to foreign customers, the furnishing of advisory and consulting services to the company and to its foreign subsidiaries, distributors, and licensees.

Card Manufacturing

A new card manufacturing plant, built by the Supplies Div., International Business Machines Corp., has gone into operation at Dayton, N. J.

The 127,000 sq ft facility will serve the needs of data processing machine customers in the New York-Philadelphia area. It is comprised of a single-story manufacturing building with an attached two-story structure housing administrative offices and an employee's cafeteria.

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(See your doctor)
AND A CHECK
(Send it now)
TO
AMERICAN CANCER SOCIETY

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Oxygen-Nitrogen Plant

To meet the needs of West Coast missile industries for liquid oxygen and nitrogen, Linde Co., Div. of Union Carbide Corp. will build a 300-ton-a-day producing plant at Pittsburg, Calif.

Production is scheduled for June 1959, when the first section, with a capacity of 115 million cu ft a month begins operation. A few months later, when additional equipment will go on stream, the plant will have a total capacity of more than 220 million cu ft a month.

LATEST CATALOGS

Fluid Power Drives

A 32-page illustrated bulletin, 10600, on Any-Speed drives has been released by Oilgear Co. The new bulletin explains the advantages, operation, and characteristics of the company's drives and illustrates them with typical performance curves and block diagrams on different types of rotary applications.

Industrial Valves

Ohio Injector Co. has published a new condensed version of its General Catalog which lists its complete line of industrial valves.

The catalog lists more than 95 per cent of the line, condensed into 28-page form. Valve figure numbers are indexed for reference by topics; face to face dimensions are supplied in full size ranges. A section on bronze brazed joint valves as well as its corrosion resistant nickel-iron line is included in the catalog.

Conveyor Belt Carrier

Stephens-Adamson Mfg. Co., has announced the availability of a new conveyor belt carrier bulletin, No. 355.

The new literature features technical data, specifications and illustrations on ball bearing carriers, Simplex carriers, deep-trough carriers, super Simplex carriers, impact carriers, standard and heavy-duty flat belt carriers, Auto-Tilt carriers, rubber disk-type return rollers, automatic belt-training carriers, automatic belt training return rollers, guide rollers, picking table carriers, and belt conveyor trippers.

Use a CLASSIFIED ADVERTISEMENT
For Quick Results

NEW WELDING PROCESS used to fabricate reactor test vessel

Job Report Courtesy of Newport News Shipbuilding and Dry Dock Company

the ARCOS EB* WELD INSERT

To simplify and speed joining the halves of this pressure vessel shell, and insure corrosion resistant root passes, a preplaced Arcos Consumable Insert was used. With this method, *only outside welding* was required to produce sound welds with uniform contours on the inaccessible inside surface. The welds readily passed Radiograph inspection for freedom from porosity, slag and other inclusions. The EB Weld Insert can save *you* time and money. Write for details. ARCOS CORPORATION, 1500 S. 50th Street, Philadelphia 43, Pa.

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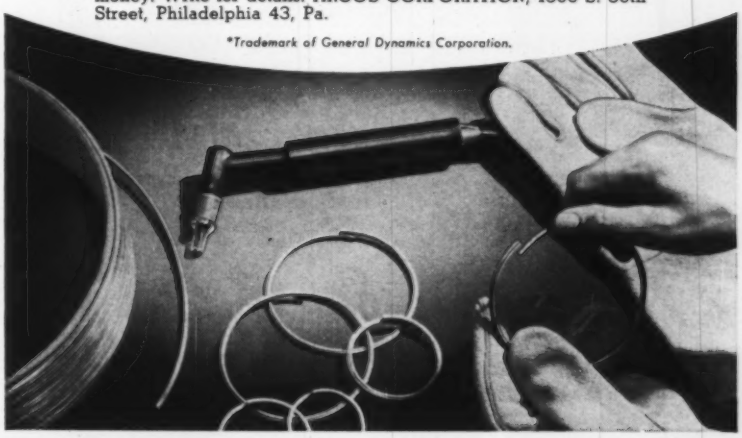

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Hydraulic Control Systems

Hydraulic controls, actuators, and power units for industrial processes, test facilities, and machine automation are illustrated and described in Bulletin GR-58-4 offered by General Regulator Corp.

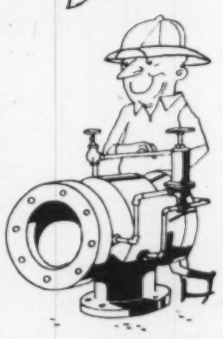
Diversified Products

A 24-page booklet describes diversified products of Fischer & Porter Co., manufacturer of flowmeters, process instrumentation, data reduction and automation equipment, chlorination equipment and glass products.

CUSHION THAT SURGE

G-A *Cushioned* Surge Relief Valve

A sudden surge of power can be disastrous, but such excessive pressure in your water lines is quickly relieved by the Golden-Anderson Surge Relief or Surge Arrestor Valve. The surge relief valve opens immediately when line pressure reaches pilot setting—the surge arrestor valve anticipates surge and opens on subnormal pressure to prevent surge.



Sizes 2½" to 36" Pressures up to 400 psi.

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Designers and Manufacturers of VALVES FOR AUTOMATION

Chart Tapes

More than 435 pressure-sensitive tapes of many sizes, colors, and patterns for making graphs, charts, layouts, printed circuit drawings, map overlays, slides, and other presentations, are illustrated in an enlarged 32-page booklet by Chart-Pak, Inc.

The booklet includes directions for making office and plant layouts and organization and flow charts. Also described are plastic grid sheets, the new Tape Pens, and other aids for the chart-maker, layout man, or engineer, including adhesive-backed pictographs, office furniture templates, work flow and data processing symbols, and newspaper and advertising borders.

Single Phase Motors

Details on ½ to 1 horsepower single phase motors for belt driven fans and blowers are included in a brochure released by the Electric Motor Div., A. O. Smith Corp.

Types and ratings, voltages, operational characteristics, mountings, and dimensions of the full model line are reported. Exploded photographic illustrations show design and construction details of each component used in models in the single phase motor line. Capacitor-start models are available, with or without automatic reset overload protector.

Gas, Vapor Heater

An eight-page brochure by Brown Fintube Co., reports on efficient and economical heating that can be accomplished for nearly any gas, vapor, or liquid.

The improved Type 102 heater is described and the bulletin serves as a convenient guide for analyzing the advantages that result from indirect-fired heaters. These include the elimination of heat wasting refractories, fast heat-up and rapid shut-down, sensitive response to load changes, high heat transfer ratio, low tube wall temperatures, variety of installation positions, modular construction and no process fluid contamination.

Flexible Couplings

A four-page brochure containing design and application data on newly-designed Amerigear series GC continuous sleeve flexible couplings is available from the Mechanical Power Transmission Div., Zurn Industries, Inc.

It describes how the combination of exclusive fully-crowned tooth, positive hub seals, and a new one-piece sleeve design can result in lower initial costs and decreased operating and maintenance costs. Selection data, step-by-step assembly and disassembly instructions, recommended lubrication specifications, ratings and dimensions are included.

KEEP INFORMED

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Gas Regulators

Oxweld industrial gas regulators are described and illustrated in a 20-page catalog available from Linde Co., Div. of Union Carbide Corp.

The catalog includes specifications and ordering information for 47 regulators that are available for use with all industrial gases. Inlet and outlet connections are listed according to the American Standards of the Compressed Gas Association. In addition to covering single- and two-stage regulators for station and manifold service, the catalog also describes a new line of CO_2 regulators and regulator manifolds for use in late model pre-mix beverage dispensing machines. Recommended uses and installations are included in the description of each regulator.

Couplings Catalog

Snap-Tite, Inc. has issued a new general catalog describing the company's standard line of quick-connect, quick-disconnect couplings.

The five basic couplings shown include the H coupling for high pressure applications; the IH coupling for impact in air lines; the Hi-Flow coupling for low pressure applications; the E coupling for vacuum and very low pressures; and, the T coupling for hard to handle fluids.

Precision Stamped Gears

Fastex Div., Illinois Tool Works has published a 20-page booklet illustrating examples of precision stamped gears and listing major applications, size limits, materials and finishes.

Information given in the new publication includes gear-design suggestions, tips for saving time and avoiding mistakes in the procurement of gears, and basic gear dimensional data. Also included are a full description of the anti-backlash feature, and gear-tooth formulas and terms.

Steam Turbines

Design and construction features of Allis-Chalmers WA-series steam turbine-generating units rated 2000 through 16,500 kw are covered in 40-page bulletin released by the company.

The bulletin carries cross-section diagrams of each of the four basic types of the units designed for condensing, noncondensing, condensing automatic extraction, and noncondensing automatic extraction operation. Turbine construction features covered include casings, glands, spindles and wheels, blades, nozzles and diaphragms, bearings, governing system, stop and throttle trip valves, insulation and lagging.

Hose Fitting Adapters

An expanded line of adapters for reusable Hoze-lok fittings for industrial hose is presented in Catalog 4490, issued by Parker Fittings & Hose Div., Parker-Hannifin Corp.

Included are various styles of connectors for male pipe threaded ends, swivel nut ends.

Liquid Strainer

Golden Anderson Valve Specialty Co. has announced Bulletin W-6SC, covering its self-cleaning liquid strainer.

The folder gives dimensions, a general list of materials and a parts list of the unit.

READY NOW - - *Volume I*

IN PRESS - - *Volume II and Volume III*

HANDBOOK OF AUTOMATION, COMPUTATION, AND CONTROL

Edited by E. M. GRABBE, SIMON RAMO, and DEAN E. WOOLDRIDGE, all of the Ramo-Wooldridge Corporation.

Here's the one complete handbook which provides all levels of technical personnel with up-to-date information about automation, computation, and control. Edited with system engineering emphasis in mind, it is packed with data applicable to research, development, and design in the fields of feedback control, computers, data processing, control components, and control systems. Throughout the work, the 106 contributors stress the new techniques and components which you can use to design and build digital devices, make measurements, and develop control systems. Much of this material has never before been available in handbook form.

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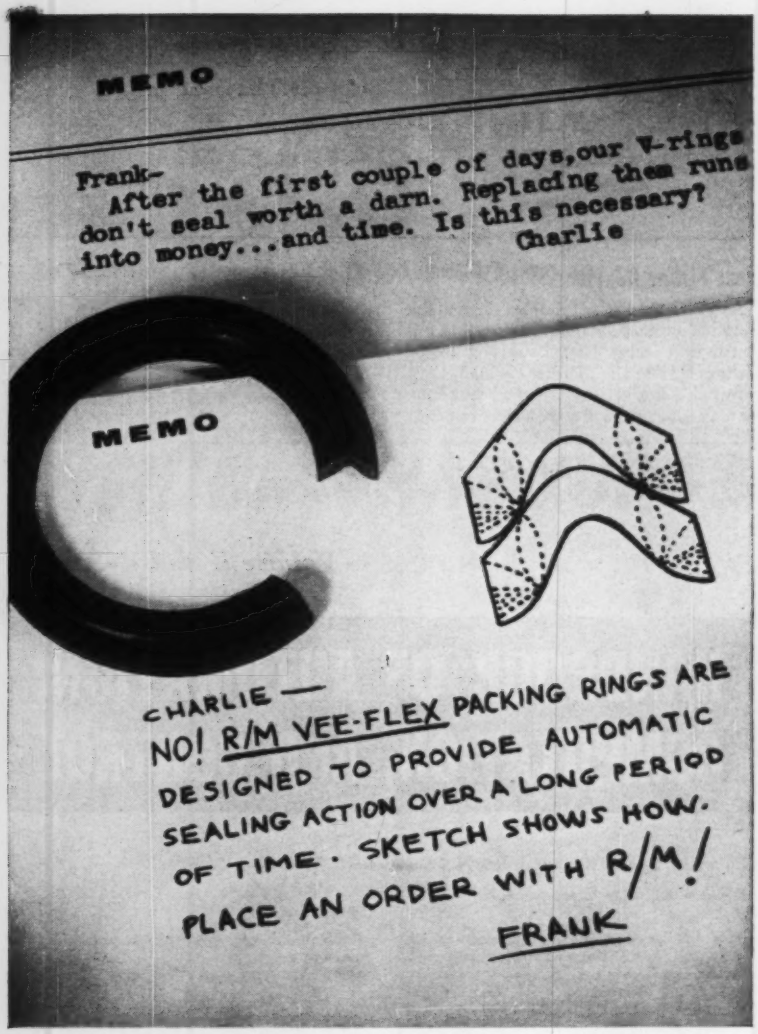
MEMO
Frank—
After the first couple of days, our V-rings don't seal worth a darn. Replacing them runs into money... and time. Is this necessary?
Charlie
MEMO
CHARLIE —
NO! R/M VEE-FLEX PACKING RINGS ARE DESIGNED TO PROVIDE AUTOMATIC SEALING ACTION OVER A LONG PERIOD OF TIME. SKETCH SHOWS HOW.
PLACE AN ORDER WITH R/M!
FRANK

Ordinary V-rings, with their flat surfaces, provide little or no automatic sealing action against the walls of the cylinder, with the result they quickly lose effectiveness. This means, of course, loss of power and eventually a maintenance problem. R/M Vee-Flex Packing Rings are specially designed to solve it for you. Convexly curved surfaces where the rings meet and thinner cross section at the apex of each V cause a flexing action which makes a firm seal on the shaft and stuffing box wall and between rings

R/M Vee-Flex Rings are available in many compositions to meet the hazards of various applications: high temperatures, high pressures, fast cycling, corrosion, or combinations of these.

R/M's engineers have amassed a wealth of experience in manufacturing packings and gasket materials to meet the most exacting requirements of industry. This experience is at your disposal—call on R/M.

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Fluid Power Pump

Bulletin 47550, announced by Oil Gear Co., describes its new Power Saver pump, an integral infinitely adjustable pressure unloading control with a range of 200–1100 psi and adjustable volumes up to 3100 cipm.

Features, operations, and specifications of the new radial piston, variable displacement fluid power pump are discussed. Photos and dimensioned drawings cover clockwise and counterclockwise pumps, adapter and angle bracket mountings, standard reservoir base with pump and motor mounting.

Vibration Mountings

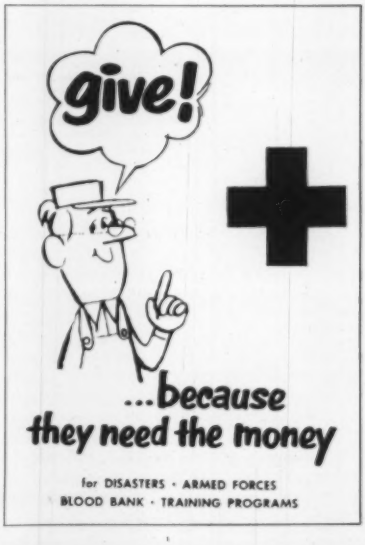
A 16-page product bulletin describing Temproof mountings is available from Lord Mfg. Co. The mountings are designed primarily to protect airborne electronic equipment against shock and vibration in the temperature range from −80 to +250 F. Bulletin No. 710 contains engineering data, including tables and transmissibility curves, on design and performance of three types of mountings.

Ball Bearing Trolleys

Ball bearing trolleys and how they work in maintaining the efficiency of trolley conveyors are described in detail in a book published by Link-Belt Co.

Book 2636 contains 20 pages of data on the types and sizes of trolleys available; selection of new trolleys and attachments; and the replacement of units in existing installations. It also includes application and maintenance information along with data on trolley wheels, rollers for roller turns and special types of trolleys which are available for electrified and heavy duty foundry applications.

Continued on Page 151



User-survey shows—in all operating categories

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Simplest Construction:

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Most Efficient:

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- VALVE A
- VALVE B

Quietest:

- FEATHER VALVE
- VALVE A
- VALVE B

A recent survey among compressor-users showed this marked preference in all four operating categories for the amazing Feather* Valve. The Worthington Feather Valve is the lightest, fastest-acting compressor valve available. Because of its lightness and flexibility it provides very sharp action with virtually no slip or back-flow. And because it works with no impact . . . has no buffer plates or cushioning devices . . . it is all but indestructible, assures long-life with negligible maintenance costs.

To get the most in performance when you buy your next compressor, specify Worthington with the rugged Feather Valve feature. Worthington Corporation, Harrison, N. J.

*REG. U.S. PAT. OFF.

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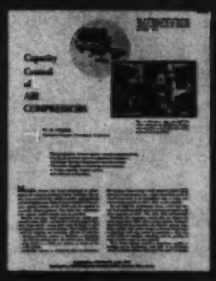

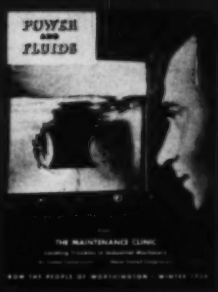

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on water-cooled compressors

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WORTHINGTON

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Temperature Indicating Controller

A brochure issued by Fenwal, Inc. describes its 541 temperature indicating controller.

The mechanical design of the controller is illustrated with photographs. It describes the variety of housing styles, temperature ranges and switching mechanisms available.

Flight Simulator

Bendix computer div. announces a 24-page bulletin on its 3-dimensional flight simulator comprised of a 3-axis flight table and a complementing analog computer.

Control with this new system reduces or eliminates the need for expensive trial flights in debugging airborne systems, the booklet reports.

Refractory Brick

A booklet on refractory brick and other shapes for industry has been published by Norton Co.

The 24-page publication is designed to aid in selecting the proper refractory products for high temperature applications. It includes technical data, tables, graphs, conversion charts.

Dry-Type Transformers

GEC-1600 a 20-page bulletin for specifying and ordering General Electric's line of dry-type transformers for commercial and industrial building applications, is announced by the company.

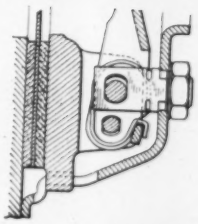
Popular ratings and sizes for 60-cycle, indoor and/or outdoor, single- and three-phase applications are included in the illustrated publication. Transformer types are shown in a pictorial index which also lists applications and gives a basic description of each unit. Price, dimension, and ordering information is given for control, quiet type M, industrial type D, and voltage stabilizing transformers; integral distribution centers, mercury lamp ballasts; and portable oil and insulation testers.

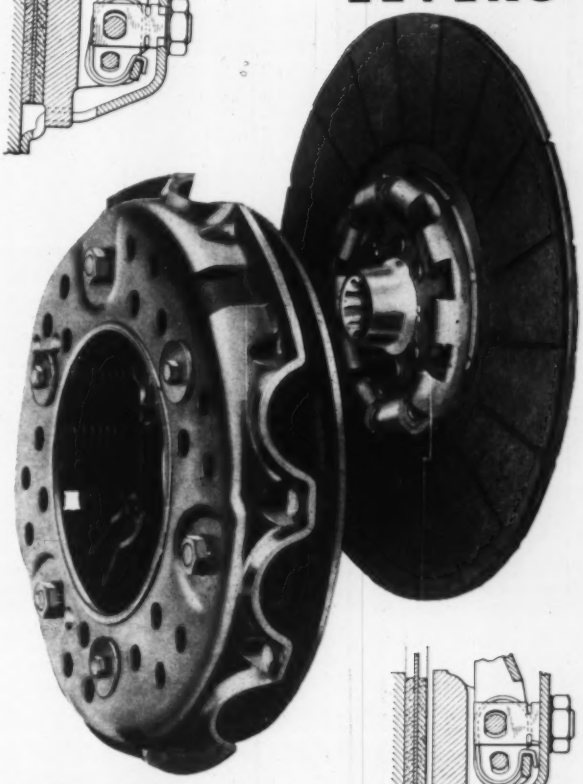
Pumps, Valves, Cylinders

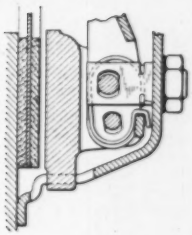
Engineering data on fluid power motors, pumps, valves, and cylinders has been published in a four-page bulletin by Commercial Shearing & Stamping Co.

Bulletin 100-P3, pictures each type of component, describes features, and includes tables of design and application data. Covered are dimensions, pressures, and input and output of motors and pumps; pressure drop tables and dimensions for control valves; and size, displacement, and effective area tables for single-acting, double-acting, and telescopic cylinders.

ROCKFORD CLUTCH LEVERS •



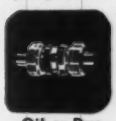




Small Spring Loaded

Automotive Spring Loaded

Heavy Duty Spring Loaded



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Speed Reducers

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Hydraulic Pumps, Motors

Catalog No. 111, published by Tuthill Pump Co., describes the company's new line of Powermax hydraulic pumps and fluid motors.

These oil hydraulic pumps are furnished in seven models with capacities from 1.2 to 14.2 gpm; for continuous service pressure to 1500 psi; speeds to 3600 rpm. Spur gear hydraulic motors are furnished for continuous pressures to 1500 psi. The catalog gives construction features, performance curves, data on pump-motor combinations, duplex or tandem models and geared flow dividers.

Magnetic Motorized Valves

Mercoid Corp. announces a 24-page catalog, V-58, which illustrates and lists specifications of magnetic and motorized valves for use with air, water, gas, steam, oil, and refrigerants.

Also included are solenoid coil rating tables. Another feature consists of two flow charts-one for liquids, the other for compressible fluids. Dimensional drawings are included.

Compressors

A bulletin covering the medium-pressure line of Spiraxial compressors produced by Roots-Connersville Blower Div., Dresser Industries, Inc., presents design and construction data as an aid to proper selection and application of this equipment in process industries.

The bulletin presents the range of capacities from 1000 cfm to 12,000 cfm for pressures up to 15 psig. Seventeen sizes are listed, with ratings and capacities for each unit included in a selection table. These capacities can be increased almost indefinitely by combining a series of compressors into multi-stage units.

Crawler Tractors

A discussion of the capabilities of large crawler tractors is given in a new 12-page booklet released by Caterpillar Tractor Co.

The booklet points up the uses of the D8 and D9 tractors in construction, logging, mining, pipelining, and railroad applications. Brief specifications are given for both machines. Photographs and drawings emphasize the features of torque converters, oil clutch, and constant live shaft power for hydraulic and cable controls, steering clutches and brake boosters.

For Consulting Engineers

Turn to Page 190

NO LUBRICATION
NO MAINTENANCE
NO WEARING PARTS

Future maintenance costs and shutdowns are eliminated when you install Thomas Flexible Couplings. These all-metal couplings are open for inspection while running.

They will protect your equipment and extend the life of your machines.

Properly installed and operated within rated conditions, Thomas Flexible Couplings should last a lifetime.

UNDER LOAD and MISALIGNMENT ONLY THOMAS FLEXIBLE COUPLINGS OFFER ALL THESE ADVANTAGES:

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Gravity Conveyor

A 16-page brochure describing its rapid-wheel gravity conveyor has been released by Rapids-Standard Co., Inc.

The bulletin, RW-58, deals with various applications to which gravity wheel conveyors have been adapted. Pictures, drawings, diagrams, and specification tables, are included. The bulletin deals with selection of conveyors, construction features, and accessories which are available for conveyor adaptations.

Gage Valves

Two new data units, Nos. 333 and 334, covering design features and giving specifications on liquid level gage valves, are announced by Jerguson Gage & Valve Co.

The valves are union bonnet type with union connections to the gage and are available with a new design outside screw and yoke bolted bonnet with backseating stem. They are recommended for pressures to 4000 psi at 100 F.

Basic Switches

Micro Switch, Div. of Minneapolis-Honeywell Regulator Co., has published an enlarged, 32-page edition of its Basic Switch Catalog, No. 62c.

Innovations in basic switches for industrial and commercial applications have been added. Among the new switches listed are high-precision roller lever switch, which has extreme stability of characteristics; adjustable actuator switch for convenient fine adjustment; and pulse switch, which offers a means of securing electrical impulses without need for complicated actuating mechanisms.

Titanium Machining

Machining recommendations for titanium are outlined in a new eight-page brochure published by Mallory-Sharon Metals Corp.

The booklet discusses the fundamentals of machining titanium, the factors which affect machinability and the basic requirements necessary. Separate pages give suggested speeds, feeds, and tool angles on turning, milling, drilling, tapping, grinding, and reaming. Recommendations for abrasive sawing, hack sawing, and band sawing operations are covered.

Air Conditioning Unit

American Air Filter Co. has published a bulletin describing its new line of Herman Nelson multi-zone air conditioning units.

Bulletin No. 870, eight pages, contains a description of components and accessories as well as capacity and specification data. One page is devoted especially to the Roll-O-Vent automatic filter section.

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LOW COST WELD END EXTENSION

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- Positive flange cost economy.

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- Heavier walls than either pipe or rolled plate—greater corrosion and pressure resistance.
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IN COMBINATION:

- Economy in lengths beyond 12″ overall as compared to Seamless Welding Necks.
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- Extension may first be welded to vessel, then flange welded to extension without refacing the flange.

Write today for detailed specifications.

See our standard line of pressure vessel connections on pages 1128-1129 in the 1958 Chemical Engineering Catalog.

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LENAPE HYDRAULIC PRESSING & FORGING CO.
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4-D Wrought Iron

A four-color booklet, illustrating in-service and laboratory tests conducted with 4-D wrought iron and other metals has been issued by A. M. Byers Co.

The eight-page booklet described what 4-D wrought iron is, and how its corrosion resistance was increased so that now it is 25 per cent more corrosion resistant than standard wrought iron. Three pages are devoted to installation reports of condensate lines, high temperature services, hot water lines, brine lines. heat exchangers, smoke stacks, tanks and gas lines.

Flexible Conveyors

Method of constructing belt conveyor systems with steel wire rope instead of rigid framing is described in a new specification sheet, No. NR-6C, by Joy Mfg. Co.

Called the Limberope conveyor, the system suspends flexible roller idlers between parallel strands of rope. The bulletin gives descriptions and dimensions of components, plus idler and support stand spacing data for belts in varying conditions.

Hydro-Pneumatic Accumulators

The different applications, sizes and types of its hydropneumatic bladder-type accumulators are described in a six-page brochure, PR-200, available from Greer Hydraulics, Inc.

Both the standard 3000 psi line and the 6000 psi line are illustrated. Included are eight basic accumulator circuit applications, dimensional data, selection information for hydraulic circuits requiring pressure storage, primary power reduction, emergency power, pressure-volume compensation, shock absorbing, leakage compensation, transfer barriers and fluid dispensing.

Cutting, Grinding Fluids

A booklet covering cutting and grinding fluids has been published by Keystone Lubricating Co.

Designated as Bulletin BK-21, the 12-page booklet describes the firm's line which includes three oil-type and three water-type lubricant-coolants. Illustrated with photographs of typical metalworking operations, the bulletin covers choosing the right cutting and grinding fluid for a particular operation. A three-step selection guide is included.

Electro Clutches

Electro clutches, described as compact, electrically operated devices for engaging and disengaging machinery gears and drives, are featured in a catalog published by I-T-E Circuit Breaker Co.

The 20-page catalog, No. 6304-1A, gives examples of actual applications, provides data and specifications on the complete cluth line and summarizes general application information. The clutch provides instantaneous pushbutton or automatic programming control of machine tools, drives, transmissions, and other shaft-driven machinery.

Remote Controls

Crown Controls Div. Trimount Instrument Co. has made available an eight-page catalog on its line of Hydra-Trol remote controls.

The catalog describes the operation and construction of the controls together with typical applications in the industrial, marine, research, and military fields. The controls are manual-hydraulic positioning devices and feature a two direction positive stroke combined with immediate synchronization in either direction. The hydraulic system is self-contained.

1956 MANUAL OF CONSULTING PRACTICE FOR MECHANICAL ENGINEERS

A Guide for Consulting Engineers and Their Clients

It sets forth the proper approach in obtaining professional engineering services, in establishing the fundamental structure in engineering agreements, and in setting up conditions applicable to the conduct of engineering assignments under various types of agreements.

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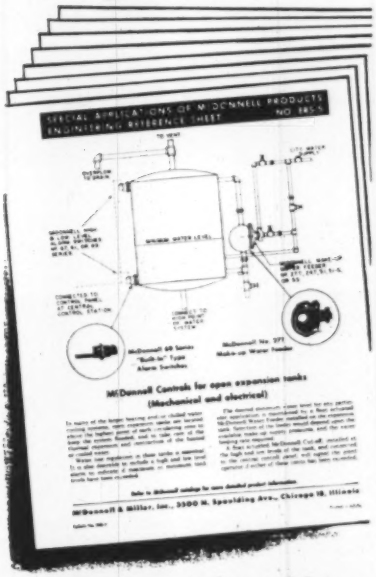

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- Stand-by pumps
- Cooling towers and chilled water systems
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The simple diagrams and explanations are likely to suggest solutions to many of your operating problems.

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Tubing, Fitting Covers

Glo-brite Products, Inc., has issued a folder giving specifications, dimensions and prices of polyfoam low temperature pipe covering, copper tubing and fitting covers.

The folder shows application photos of its products and gives data on its use in refrigeration installations. Ordering instructions and information on sundries, adhesives and accessories are included.

Instrumentation Systems

A new 1958 catalog digest has been issued by Panoramic Radio Products, Inc. Expanded to 12 pages, the catalog includes instruments, some of which are said to be entirely new to the field, complete instrumentation systems, improved features, and informative descriptions.

Grouped for easy reference are sections covering automatically scanning spectrum analyzers for low frequency, ultrasonic, radio frequency, and microwave ranges, response curve tracing and other unified systems; special purpose analysis instrumentation; asscessory instruments; and telemetering systems test equipments.

Heat Exchanger

A 12-page illustrated bulletin describing its Fin-Pak heat exchanger has been issued by Air Preheater Corp.

The unit is a recently introduced heat exchanger that can operate with low-pressure drops under high pressure differentials for gas to gas, gas to air, or gas or air to liquids. Five advantages of the unit to a variety of fuel burning and process equipment applications are detailed in two pages.

Automatic Transfer Switches

How to select an automatic transfer switch, and applications of this equipment are covered in a booklet issued by Automatic Switch Co.

Publication 596R1 discusses such requirements as inrush capacity, continuous duty rating, rapid transferral of load, high thermal capacity and ability to withstand electromagnetic effects, double source control, full phase protection, and various structural and operational features. The publication also briefly describes installations of transfer switches.

Metal, Plastic Processes

A folder describing the variety of metal and plastic processes performed as a result of several recent corporate mergers has been published by Ainsworth-Precision Castings Co.

Design and production data is given for many of the following processes: die casting, stamping, precision machine parts, metal forming, plastic molding, welding, assembly, automatic plating, automatic polishing and buffing, painting and die making.

Pantex SPEEDYLECTRIC STEAM GENERATOR

Ideal Answer to
10 PROBLEMS
in Supplying Steam

- **Without flame, flues or stack**
- **At higher pressures or temperatures**
- **At adjustable pressure or temperature**
- **With a constant high quality**
- **Without long steam lines**
- **To serve summer processing needs**
- **To meet extra load needs**
- **For lab, test, or pilot-plant use**
- **Where an unattended boiler is desired**
- **Where boiler space is limited**

In many such situations, a Speedylectric Steam Generator is the best or only solution. Using the electrode method of generating steam electrically, completely safe anywhere, its design eliminates low-water hazard and practically removes the need for supervision. Generation is fast, by the simplest and most economical electric method, and adjusts automatically to meet load demand. Upkeep is nil . . . there are no coils, tubes or heating elements to scale or burn out. Sizes from 2 to 50 Bhp, 15 to 500 psi. Higher pressures are available. Electric power 220, 440, or 550 volts A. C. UL listed, ASME code.

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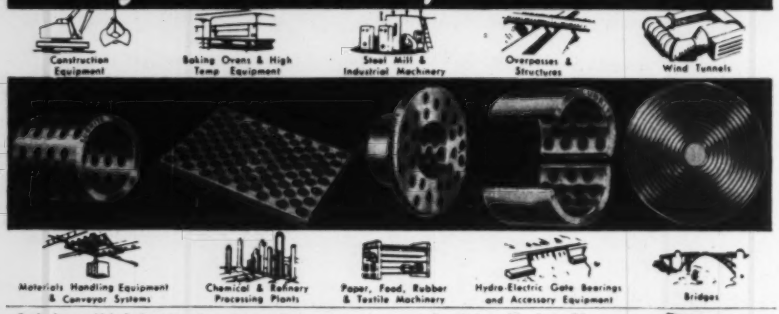
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Lubrite self-lubricating bearings offer great versatility in hundreds of fields where dependability and superior performance are of prime importance.

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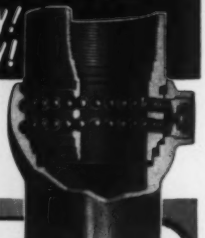

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Heavy Duty V-Belt

A four-page color bulletin issued by Manhattan Rubber Div. Raybestos-Manhattan, Inc. describes a new Condor LS V-belt made for long center, heavy duty drives.

The belt features a precision proportioned construction reported to eliminate V-belt whip and turn-over that leads to belt failure. It is also claimed the new belt stays matched with a degree of lateral and longitudinal stability never before possible with long center drives.

Aluminum Welding

Aluminum Co. of America has published a 190-page hard-bound book on the welding of aluminum.

Covered are such topics as selecting the method for welding—inert gas tungsten arc, inert gas consumable electrode, spot and seam, flash, stud, metal arc, carbon arc-atomic hydrogen welding and gas welding. Other data covers welding aluminum castings, pressure welding, performance of welds, and inert gas arc cutting.

Paint Removing

Four methods commonly used by leading industrial plants to remove paint are described in detail in a new booklet recently published by Oakite Products, Inc.

The booklet describes 12 different paint stripping compounds—alkaline, solvent, and solvent-acid; each designed to remove different type paints, and discusses the hot-flow-on method of stripping. Tank immersion steam gun and brushing methods are also covered.

Cast Stainless Steel

A four-page folder giving technical data on cast stainless steel is available from Foundry Products Div., Cooper Alloy Corp.

The folder lists 29 heat and corrosion resistant alloys which are available from the company for the manufacture of custom castings and the firm's proprietory line of valves and fittings. It contains a cross reference chart of ACI, AISI, SAE, and ASTM designations. Data on each of the alloys listed has been expanded to incorporate nominal analyses and typical mechanical properties at room temperature. Heat treatment data is included as well as suggested applications for each of the heat and corrosion resistant alloys.

Hydraulic Presses

A descriptive bulletin on its line of hydraulic multipresses is available from Denison Engineering Div., American Brake Shoe Co.

The bulletin describes bench and floor model presses which range in capacity from 1 to 75-ton ram pressure. Various accessories such as foil feed and marking, stock feed, index table and touch control are covered in the bulletin.

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BUSINESS NOTES
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Welded Boiler Tubing

A data card published by Tubular Products Div., Babcock & Wilcox Co., lists the maximum allowable working pressures, by popular tube sizes, for electric resistance welded boiler tubing.

The information is based on the latest edition of the ASME Boiler Construction Code and covers tubing for both water tube and fire tube boilers. The data card is identified as TDC-157.

Plastic Products

Raybestos-Manhattan, Inc., has issued a catalog covering its products made of Teflon, Raylon and Kel-F.

The booklet outlines the properties of the various plastics and shows products the form of disks, rods, sheets and tubes.

Hot Lab Instruments

Bausch & Lomb Optical Co. has prepared a special manual which describes and illustrates its remote control steromicroscope and the remote control metallograph. Both are standard research instruments equipped with remote relay systems for hot cell work.

The instruments have been designed to obtain results equal to those used under normal cold laboratory conditions. Versatility of the metallograph allows modification for wall-thickness, changes in relaying devices, and substitution of light sources, the firm states. Image may be viewed directly and recorded with the camera attachment. The stereomicroscope is equipped with camera for stereophotomicrography and regular eyepieces for safe, direct viewing.

Ultrasonic Cleaning

Branson Ultrasonic Corp., has issued a bulletin on the design and equipment available for ultrasonic cleaning.

Applications, advantages and capabilities of the equipment are outlined, and data is given on the firm's ultrasonic cleaning principles, system arrangements, and various generators and cleaning transducers.

Hydraulic Hose Assemblies

Catalog No. 57-S, issued by Anchor Coupling Co., illustrates and describes hydraulic hose assemblies, couplings and fittings.

Included are descriptions of ductile sleeve couplings and other permanently applied couplings with 2-wire braid hose for high pressures and 1-wire braid, 2-rayon braid, or spiral wire braid for medium and low pressures.

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EXTREMELY HIGH EFFICIENCY
Required head and capacity delivered with lower HP motors. Saves space, saves initial outlay, saves operating costs.

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Saves head room where critical suction conditions exist

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Exclusive features enable easy disassembly without disturbing pump-motor alignment or discharge piping

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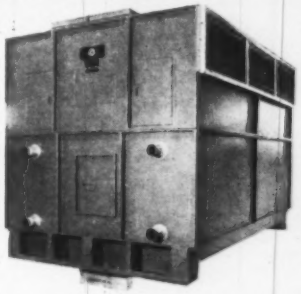
This Self-Contained Fluid Cooling System

. . . gives most accurate temperature control



Applied in cooling industrial machines or processes to temperatures approaching the ambient wet-bulb, the NIAGARA *Aero* HEAT EXCHANGER is independent of any more than a nominal water supply or disposal. The coolant system is a closed one, free from dirt and maintenance troubles.

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Heat is rejected outdoors. Only the little water evaporated on the cooling coils in the air stream, or discharged to prevent hardness build-up, is consumed.

Niagara sectional construction saves you much installation and upkeep expense, gives full access to all interior parts and piping. Your equipment always gives you full capacity and "new plant" efficiency.

Write for Niagara Bulletin No. 132 for complete information

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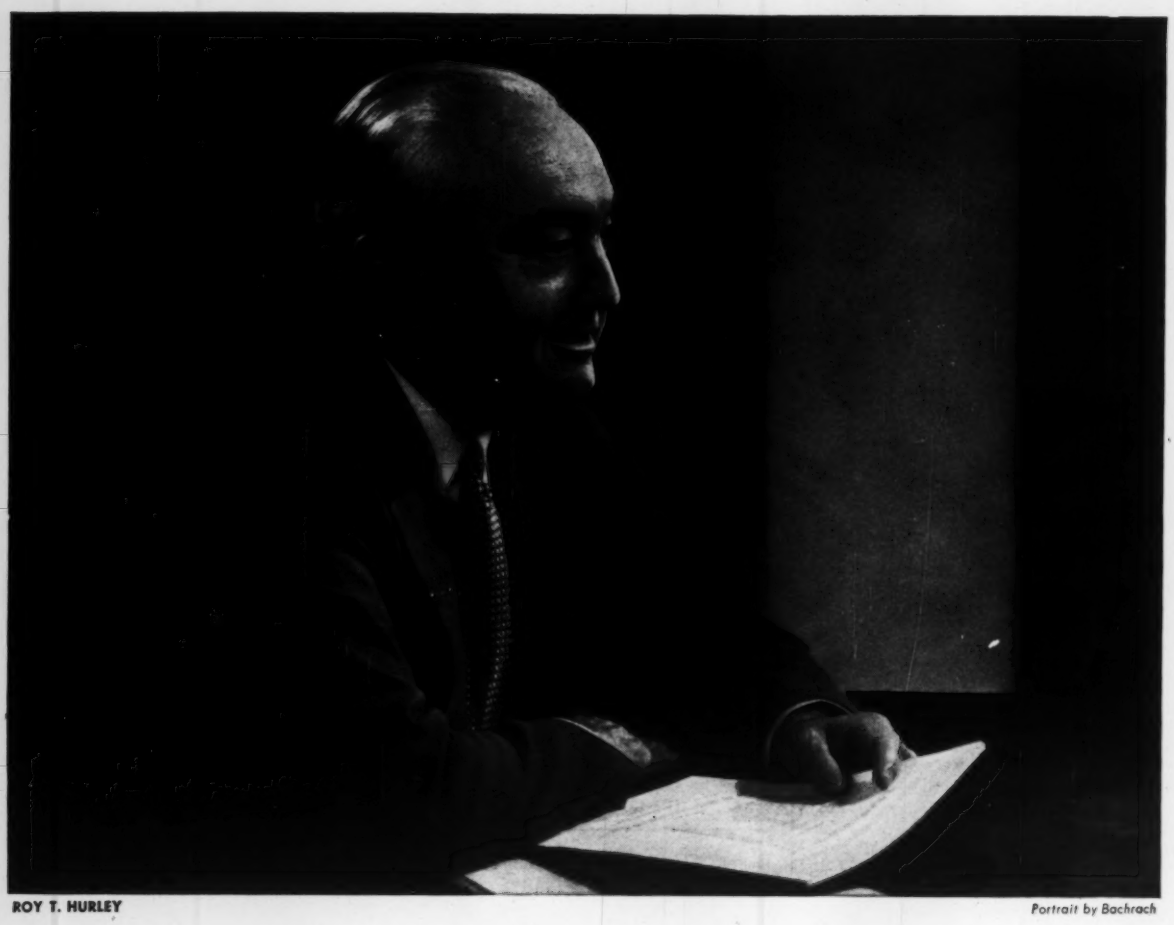

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ROY T. HURLEY, ***Chairman and President, Curtiss-Wright Corporation***

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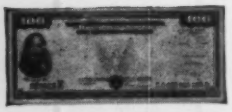

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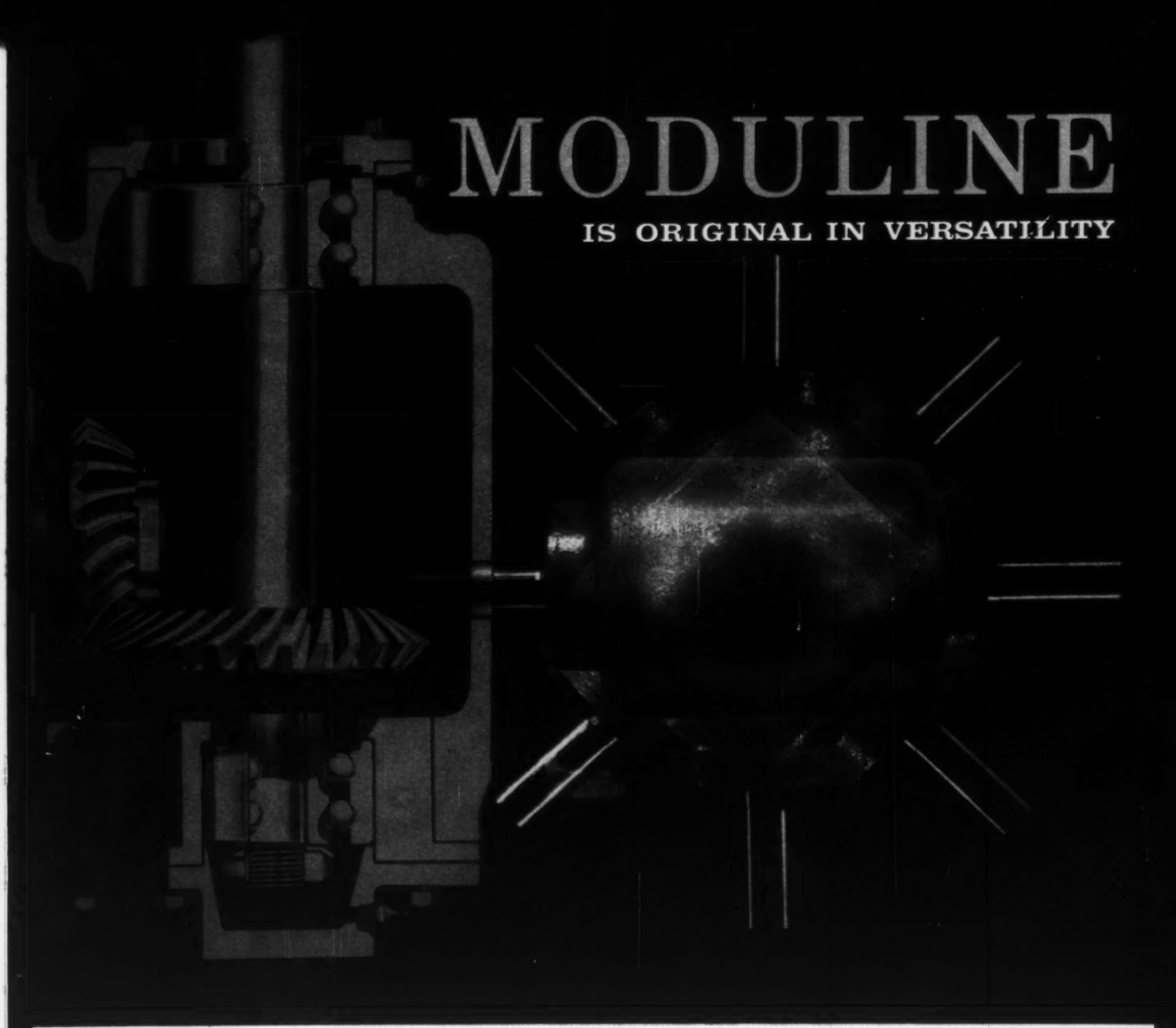

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Will a right angle drive solve your next speed reduction problem? Only Westinghouse offers Moduline units with right angle input or output assemblies as attachments to basic units. These 1 to 75 hp reducers with ratios from 7.6:1 to 985.3:1 can handle any job.

Right angle output shafts can be indexed to any of 8 or 12 positions for power take-off in any direction. Power can be put into or taken out of the reducer with belts, chains or gears.

Famous Westinghouse ground-tooth helical gears, matched spiral bevels, splined internal shafts and Moduline serviceability make these the most efficient and flexible speed reducers you've ever seen.

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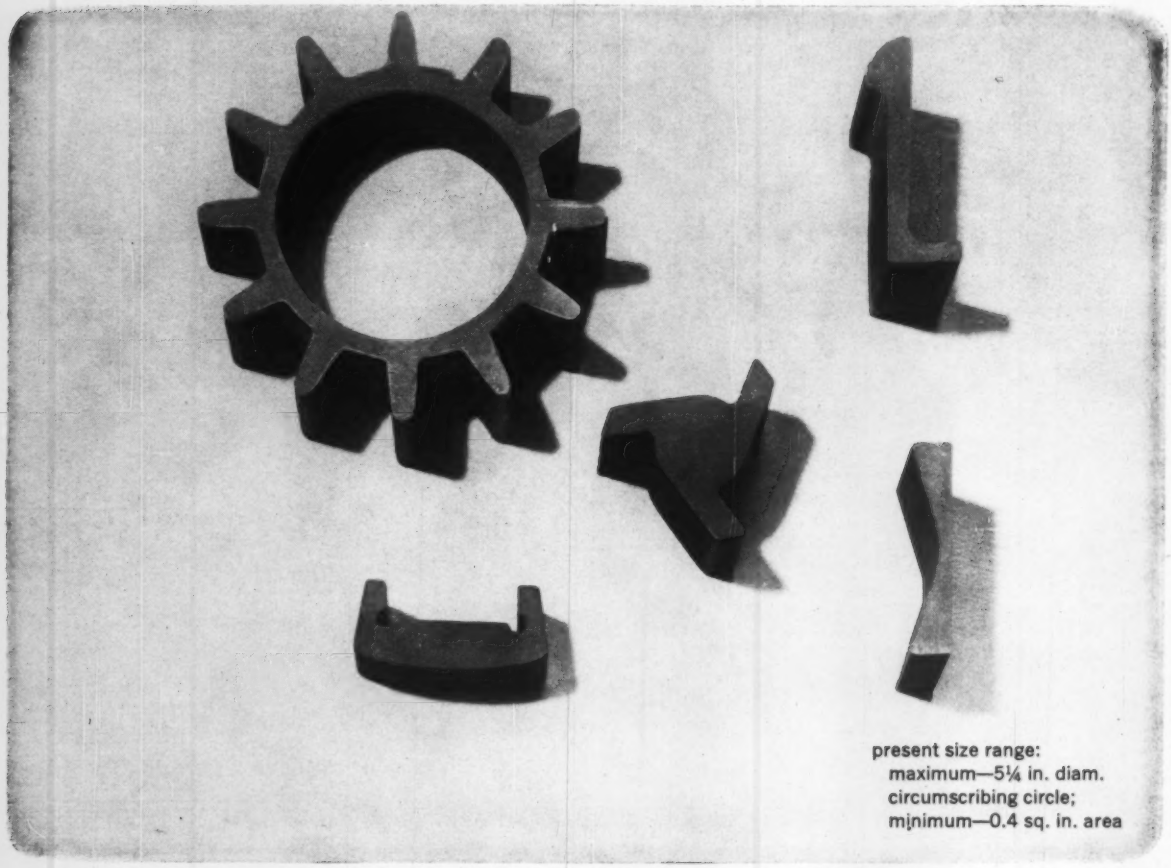

present size range:
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- Tool Steel Atlas 93
- SAE 4130
- 410 Stainless

Why hog out intricate shapes like these? Let A-L extrude them in any steel

If you're hogging out sections, paying for special mill rolls on small orders, or waiting for minimum rolling mill tonnages, Allegheny Ludlum Steel Extrusions are your answer. They will save you scrap loss, slash your machining costs, hold down your inventory requirements and cut delivery time.

Extruded shapes save money on expensive materials and on costly machining. Non-ferrous applications in the last decade have proven it. Now even greater savings are possible with tough, strong metals in Allegheny Ludlum Steel Extrusions.

Intricate extruded shapes in all stainless grades, tool steels, carbon steels, electrical steels, high temperature alloys, even zirconium and nickel alloys are now in production at Allegheny Ludlum, cutting costs in many different industries.

Costs and minimum order quantities are surprisingly low. Charge for die design is under $200. Orders taken for as little as 40 pounds.

To learn more about the time and cost-cutting possibilities of Allegheny Ludlum Hot Steel Extrusions, send for the extrusion booklet—12-pages of design and engineering information with process and product explanation, material properties, design tips and limitations, tolerances, order instructions, etc. Or call any A-L office for technical assistance. ***Allegheny Ludlum Steel Corporation, Oliver Building, Pittsburgh 22, Pa.*** Address Dept. ME-9.

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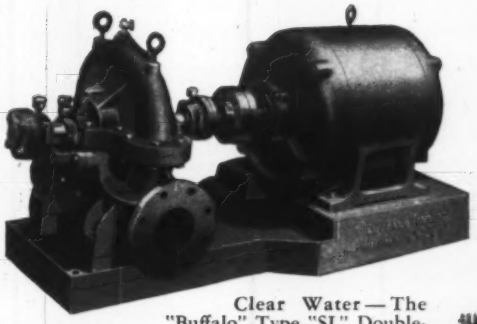
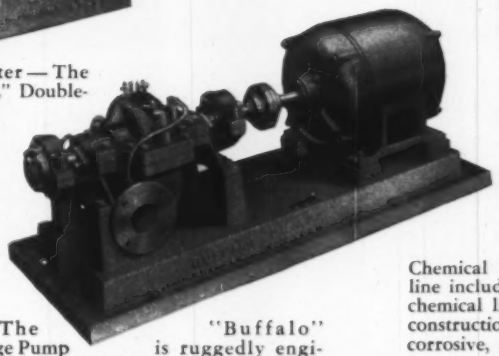
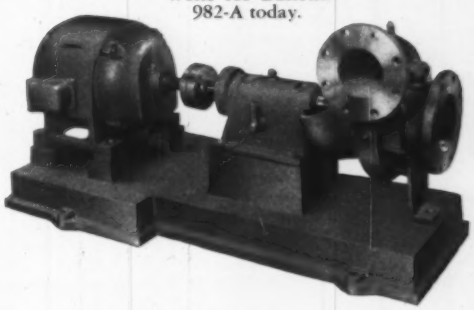


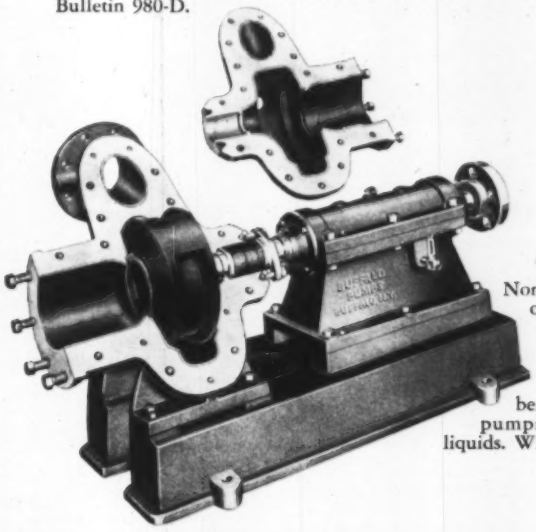
Clear Water — The "Buffalo" Type "SL" Double-Suction Pump is recognized for its highly efficient clear water service throughout industry. Capacities from 10 to 14,000 gpm. Write for Bulletin 955-R.



High Pressure — The "Buffalo" Type "RR" Multi-Stage Pump is ruggedly engineered to deliver peak efficiency on boiler feed and other clear water applications against heads as high as 1500 feet. Capacities range up to 900 gpm. For full details write for Bulletin 980-D.

Chemical Liquids — The complete "Buffalo" line includes ten specially designed pumps for chemical liquids. Available in several types of construction for handling a wide variety of corrosive, abrasive or high-consistency liquids. Write for Bulletin 982-A today.





Non-Clogging — "Buffalo" Diagonally Split-Shell Pumps are designed for moving high-consistency liquids, with down-time reduced to an absolute minimum. A number of models are available for pumping abrasive and corrosive liquids. Write for Bulletin 953-K.

WHATEVER YOUR LIQUID-MOVING PROBLEM, THERE'S PROBABLY A "BUFFALO" PUMP TO SOLVE IT!

And the fact that "Buffalo" builds a *complete line* of pumps — a type, size and capacity to fit almost every liquid-moving need — can save you money right from the start. It means you never need to pay for "more pump" than you actually require.

You'll find a "Buffalo" Pump to match your exact requirements, with complete assurance of the utmost efficiency, dependability, ease of maintenance and long-range economy. Just contact your nearest "Buffalo" engineering representative, or write us direct. We'll be glad to recommend the pump that's best-suited to your needs.

THE COMPLETE "BUFFALO" LINE ALSO INCLUDES: Heat Transfer Pumps, Close-Coupled Pumps, Sump Pumps and Raw Sewage Pumps. Special alloys available in all models.

Engineered into every "Buffalo" Pump is the famous "Q" Factor — the built-in QUALITY which provides trouble-free satisfaction and long life.

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Here are the AMERICAN STANDARDS to consult—
for approved dimensions, permissible tolerances, and other specifications covering SMALL TOOLS AND MACHINE TOOL ELEMENTS

ACCURACY OF ENGINE AND TOOL ROOM LATHES, B5.16—1952. **$1.00**
Gives the tolerances to which industry is building 12 in. to 18 in., 20 in. to 32 in., and 40 in. to 72 in. lathes and the tests for determining the accuracy of the lathes.

CHUCKS AND CHUCK JAWS, B5.8—1954. **$1.50**
Establishes controlling dimensions for all chucks from 6-in. to 36-in. diameter of both medium and heavy duty types, for an extra heavy series of chucks with serrated master jaws, for power-operated and hand-operated chucks of two-, three-, and four-jaw types.

CIRCULAR AND DOVETAILED FORMING TOOL BLANKS, B5.7—1954. **$1.50**
In this standard are the sizes and types of tool blanks and the associated mounting portions of their respective holders for use on 60 types of automatic screw machines, the latter being classified in the Standard into six different groups of comparable stock capacities. Tolerances and screw threads are specified. Typical blanks and holders are illustrated.

DRILL DRIVERS (Split-Sleeve, Collet-Type), B5.27—1951. **$1.50**
This Standard gives taper dimensions, general specifications, and the dimensions for 135 sizes of drill drivers along with the standard and optional taper number for each size.

INVOLUTE SPLINES, B5.15—1950. **$3.00**
Tables give dimensional and effective clearances, minor diameter fits, dimensions for both the flat root and fillet root types, basic measurements between and over pins, special pin measurements, and hob and broach dimensions. Provisions are made for allowable errors. Formulas are given for calculating pin measurements and torque capacities.

INVOLUTE SERRATIONS, B5.26—1950. **$2.00**
In this Standard are the tooth dimensions, the basic dimensions from which the dimensions for any serration may be calculated, tolerances for a complete gaging system, basic measurements between and over pins, formulas for calculating space width and tooth thicknesses, recommended hob dimensions, and provisions for allowable deviations.

INVOLUTE SPLINE AND SERRATION GAGES AND GAGING, B5.31—1953. **$1.50**
Factors affecting fits and their control, working and inspection gages, inspection methods, machining tolerances and allowable errors are among the subjects covered.

JIG BUSHINGS, B5.6—1941. (Reaffirmed 1949) **$1.00**
Dimensions for: Press-Fit Wearing, Renewable-Wearing and Liner Bushings.

KNURLING, B5.30—1953. **$1.50**
This standard covers knurling tools with standardized diametral pitches and includes dimensional relations with stock in the production of straight, diagonal and diamond knurling on cylindrical surfaces having teeth of uniform pitch parallel to the axis of the cylinder or at a helix angle not exceeding 45 deg with axis of work.

MACHINE MOUNTING SPECIFICATIONS FOR ABRASIVE DISCS AND PLATE MOUNTED WHEELS, B5.35—1957. **$1.50**
Establishes standards for location and size of bolt holes in steel discs wheels (machine face plates) and the mounting side of abrasive discs and plate mounted wheels. Twenty-seven illustrations supplement the text.

MOUNTING DIMENSIONS OF LUBRICATING AND COOLANT PUMPS FOR MACHINE TOOLS, B5.28—1958. **$1.00**
Tables give specific mounting dimensions for motor-driven centrifugal pumps, centrifugal and geared pumps, centrifugal pumps (flange mounted type), gear and vane pumps, and for mounting brackets.

PUNCH AND DIE SETS FOR TWO-POST PUNCH PRESS TOOLS, B5.25—1950. **$1.50**
These dimensions for back-post and diagonal-post sets cover die area, the die holder and punch holder thickness, shank diameter and lengths, guideposts and bushings, and removable punch holder shanks.

ROTATING AIR CYLINDERS AND ADAPTERS, B5.5—1954. **$.100**
Tables in this Standard show dimensions of air cylinders having 3, 4½, and 6 to 20 in. bore, the dimensions of adapters, sizes of adapter screws and tapped holes, and pull and stress data at 100 lb per sq in. air pressure.

CARBIDE BLANKS AND CUTTING TOOLS B5.36—1957. **$2.00**
Presents the standard sizes, styles, designations, dimensions and tolerances of carbide blanks, sintered carbide tipped general purpose tools, sintered carbide boring tools, solid sintered carbide inserts 1½" and longer and their holders. The recommended identification system for each group is given.

SINGLE-POINT TOOLS AND TOOL POSTS, B5.22—1950. **$2.00**
Standard defines and illustrates the different classes of tools, their parts, and the angles at which they are used. Dimensions include those for tool shanks, tool post openings, and lathe center height for solid tools and tool holders, six styles of sintered carbide tips, and the tips and shanks of tipped tools.

MARKINGS FOR GRINDING WHEELS, B5.17—1958. **$1.00**
Covering markings only, this Standard establishes a symbol for each of the most essential characteristics of a grinding wheel and arranges them in uniform sequence.

SPINDLE NOSES FOR TOOL ROOM LATHES, ENGINE LATHES, TURRET LATHES, AND AUTOMATIC LATHES, B5.9—1954. **$2.50**
Presents dimensions of each size and type of nose, of mating backs of chucks, face plates and fixtures, and of gages for checking their important dimensions. Permissible tolerances are specified. Spindle noses (types A, B, D and L) are described and recommendations given for their use on different types of lathes.

SPINDLE NOSES AND ADJUSTABLE ADAPTERS FOR MULTIPLE SPINDLE DRILLING HEADS B5.11—1954. **$1.00**
Here are the general dimensions of assembly and the detail dimensions of adjustable adapter body, set screw slot, adjustable extension adapters, adjustable adapter set screw and friction lock nuts, and spindle noses. Tolerances, finish and marking are specified.

SPINDLE NOSES AND ARBORS FOR MILLING MACHINES, B5.18—1953. **$1.00**
Contains dimensions for ends of arbor and adapter, for spindle nose, and for draw-in bolt end; also sketches of selective types of drive key construction.

STRAIGHT CUT-OFF BLADES FOR LATHES AND SCREW MACHINES, B5.21—1949. **$1.00**
Gives dimensions for the height, length, and thickness of the approved four types of blades, and includes sketches to show the optional shapes for cut-off blade stock.

T-SLOTS, THEIR BOLTS, NUTS, TONGUES, AND CUTTERS, B5.1—1949. **$1.50**
Tables show dimensions for T-slots, their tongues and cutters, and for inserted and reversible tongues and tongue seats. Tolerances are specified.

LIFE TESTS OF SINGLE-POINT TOOLS, B5.19—1946. (Reaffirmed 1953) **$1.00**
Shows how to evaluate performance of single-point tools made of material other than sintered carbides.

LIFE TESTS FOR SINGLE-POINT TOOLS OF SINTERED CARBIDE, B5.34—1956. **$1.00**
Recommendations apply to the tool shape, the preparation of the tools for tests, and the methods of testing to determine relationship between tool wear and cutting time.

TWIST DRILLS, B5.12—1950. **$1.50**
Provides dimensions and tolerances for standard straight shank drills varying from 0.0135 to 2.000 in. taper shank drills from ⅜ in. to 3½ in., and the corresponding drill lengths and flute lengths.

DESIGNATION AND WORKING RANGES OF GRINDING MACHINES, B5.32 and 33—1953. **$1.00**
Data and information supplied by this Standard apply to all sizes of reciprocating table surface grinders having horizontal spindles and to all swings of plain cylindrical grinding machines up to and including 36 in. size.

MACHINE TAPERS, B5.10—1953. **$1.50**
Presents basic dimensions for 22 sizes of self-holding tapers; detailed dimensions and tolerances for self-holding taper shanks and sockets, for the plug and ring gages applying to this series of tapers; and the dimensions for 12 sizes of steep machine tapers.

MACHINE PINS, B5.20—1958. **$1.50**
These dimensions are for hardened and ground dowel pins, straight pins, ground dowel pins (not hardened), taper pins, clevis pins, and cotter pins. An appendix gives drilling specifications for taper pins and a drill chart for the size of drill and number required.

MILLING CUTTERS, B5.3—1950. **$3.00**
Reflecting the developments in cutter design, tool material, and machine improvements are the 56 illustrated types for which dimensions are here given.

REAMERS, B5.14—1949. **$2.00**
General dimensions of thirty standard types of reamers and related tools are presented along with the magnitude and direction of the tolerances including the number of flutes in the various types.

TAPS—CUT AND GROUND THREADS, B5.4—1948. **$2.00**
32 tables gives the thread and general dimensions together with the working tolerances for nine types of taps. Supplementary material includes terminology and definitions, and instructions for making taps, dies, and other threading tools.

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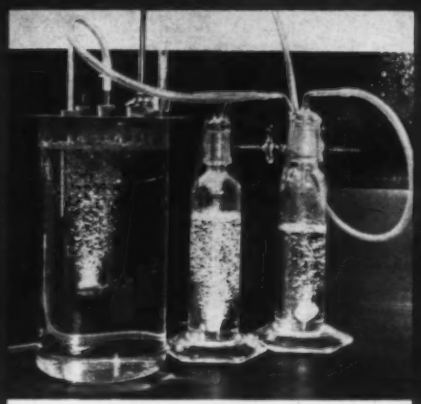
A specially designed binder for holding these Standards is available. It is 9" × 12" in size and provided with flexible steel rods which can be slipped out of or under the top and bottom metal lips. It gives every advantage of a bound book together with the added convenience which comes from the ability to instantly insert, remove or transpose sections of the contents. **Price, $3.25**

***Published by* THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS, 29 W. 39 ST., N. Y. 18**

1 Analytical weighing of specimens prior to testing



2 Steam condensate corrosion test

3 Cleaning specimens with inhibited hydrochloric acid

4 Second analytical weighing to determine corrosion weight loss

5 Calculation and statistical analysis of laboratory test results

6 Final examination of specimens under low power magnification

Extensive testing program proves new 4-D Wrought Iron more corrosion-resistant than ferrous substitutes

Test results from the Byers Research Laboratory lend documentary support to the superiority of new 4-D Wrought Iron—over standard Wrought Iron as well as ferrous substitutes.

Convincing case-history service records are now further substantiated by the conclusive findings of our metallurgical staff. Some typical results of this testing program are presented in the chart at right.

The Byers field service representative will be pleased to relate these test results to your corrosive applications. Write us for helpful literature on new 4-D Wrought Iron. A. M. Byers Company, Clark Building, Pittsburgh 22, Pennsylvania.

BYERS WROUGHT IRON

Comparative Analysis of 4-D Wrought Iron Corrosion Tests

Tests	4-D Wrought Iron	Standard Wrought Iron	Ferrous Substitutes
Severe industrial atmospheric continued exposure 17 years	Corrosion weight loss 540 grams/sq. ft.	Corrosion weight loss 655 grams/sq. ft.	Not included in test
Steam condensate return line	*At least 25% greater corrosion-resistance than standard Wrought Iron	No failures 10 years (still in service)	Complete failure after 2 years
Aerated salt water—5 weeks (Short term test—points indicate 4-D Wrought Iron curve flattening out at much lower rate of attack)	Corrosion weight loss 146 mg/sq. in.	Corrosion weight loss 170 mg/sq. in.	Corrosion wt. loss 226 mg/sq. in.
Brine piping	*At least 25% greater corrosion-resistance than standard Wrought Iron	No failures 23 years (still in service)	Complete failure after 7 years
Salt water, Gulf of Mexico ¼ inch plate—17 years	Corrosion weight loss 4 mils/years (minimum plate thickness now $\frac{3}{16}$") Still in excellent condition	Not included in test	Corrosion weight loss 30 mils/years; plate badly pitted, perforated
Downspout	*At least 25% greater corrosion-resistance than standard Wrought Iron	No failures in 29 years (Still in service)	Complete failure after 18 years

*In this application no long term test data yet available on 4-D Wrought Iron. Results shown are derived from short term tests.

TO THE MEMBERS OF———

THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

Members of the ASME are invited to name any number of engineers as candidates for membership. Engineering acquaintances should be qualified by both fundamental training and experience for one of the technical grades. Those who do not have an engineering degree may show the equivalent thereof through actual practice. Executives of attainment in science or industry may associate with the Society as Affiliates.

THE American Society of Mechanical Engineers promotes Mechanical Engineering and the allied arts and sciences, encourages original research, fosters engineering education, advances the standards of engineering, promotes the intercourse of engineers among themselves and with allied technologists; separately and in cooperation with other engineering and technical societies, and works to broaden the usefulness of the engineering profession.

As a post graduate school of engineering, the Society brings engineers into contact with each other, with leaders of thought and with new developments; it fosters the interchange of ideas, develops professional fellowships, and encourages a high standard of professional conduct—all with the purpose of advancing civilization and increasing the well-being of mankind.

O. B. Schier, II, Secretary
The American Society of Mechanical Engineers
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Pangborn Cloth Bag Dust Collector on the job. This is just one of Pangborn's complete line of wet and dry dust collectors.

See those bags? They're the *collect* in the Pangborn Cloth Bag Dust Collector. And they're efficient! The cloth filter has proved the most practical method for collecting finely divided dry dusts. But Pangborn goes a step further. Pangborn engineering has not only adapted this design to increase its collecting effectiveness but has simplified its construction. This means you save money. The Pangborn Cloth Bag Collector offers maximum efficiency, yet is economical to buy, install and operate.

Pangborn engineering is important to every dust-producing plant, regardless of the kind of collector needed. It is not enough to put a dust collector within a plant. An efficient dust collecting system must be *scientifically* planned, designed and constructed to handle effectively a specific dust problem. This thinking is incorporated into every Pangborn proposal.

The Pangborn Engineer in your area will be glad to go to work for you. He is a dust expert *and will discuss your individual problem at no obligation. And, for more information, write for Bulletin 922 to:* Pangborn Corp., *2200 Pangborn Blvd., Hagerstown, Md. Manufacturers of Dust Control and Blast Cleaning Equipment.*

Pangborn CONTROLS DUST

leading reactor builder offers

LONG RANGE CAREERS

in worldwide nuclear projects

EXPERIENCED NUCLEAR ENGINEERS AND SCIENTISTS

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Senior responsible openings. Requires related experience and degree.

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Fuel Materials: Physical metallurgists and chemists for research and development of reactor fuels. Study radiation effects, overall evaluation of uranium and thorium alloys, and ceramics. Research in gas-metal systems, emphasis on structural, phase equilibria, and material properties.
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Compact reactors and power conversion: Nuclear, mechanical engineers. Design, installation, checkout, operation, and environment tests for satellite auxiliary power plants.
Instrumentation and control: EE's and applied physicists. Design, develop, analyze, and test advanced automatic power plant control systems and components.
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Responsible positions. Degree essential. Experience as required.
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A DIVISION OF NORTH AMERICAN AVIATION, INC.
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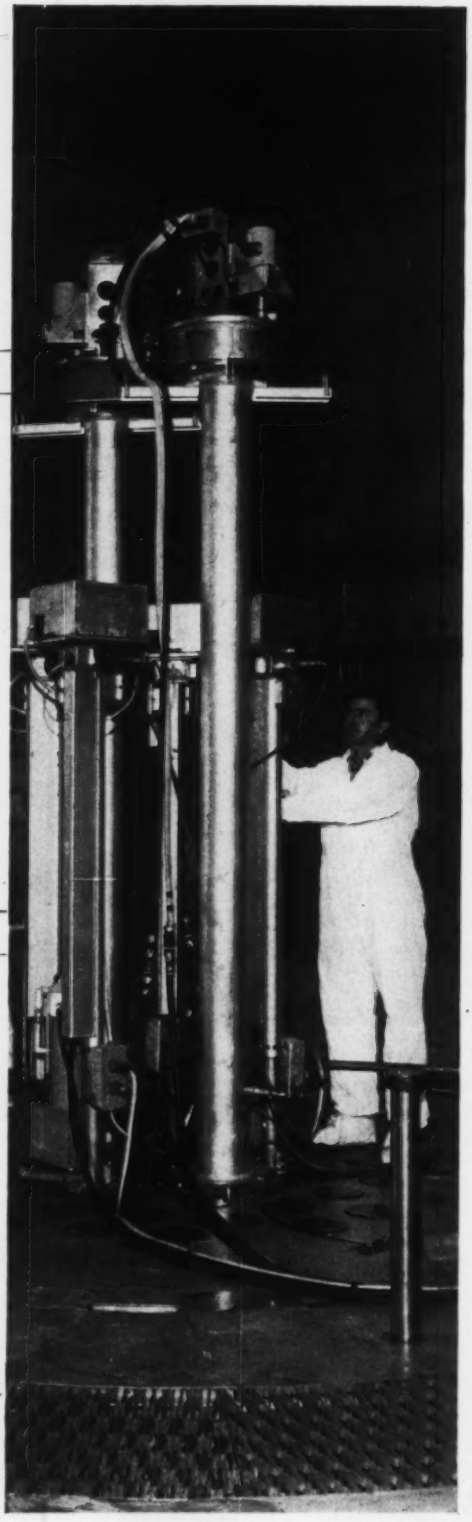
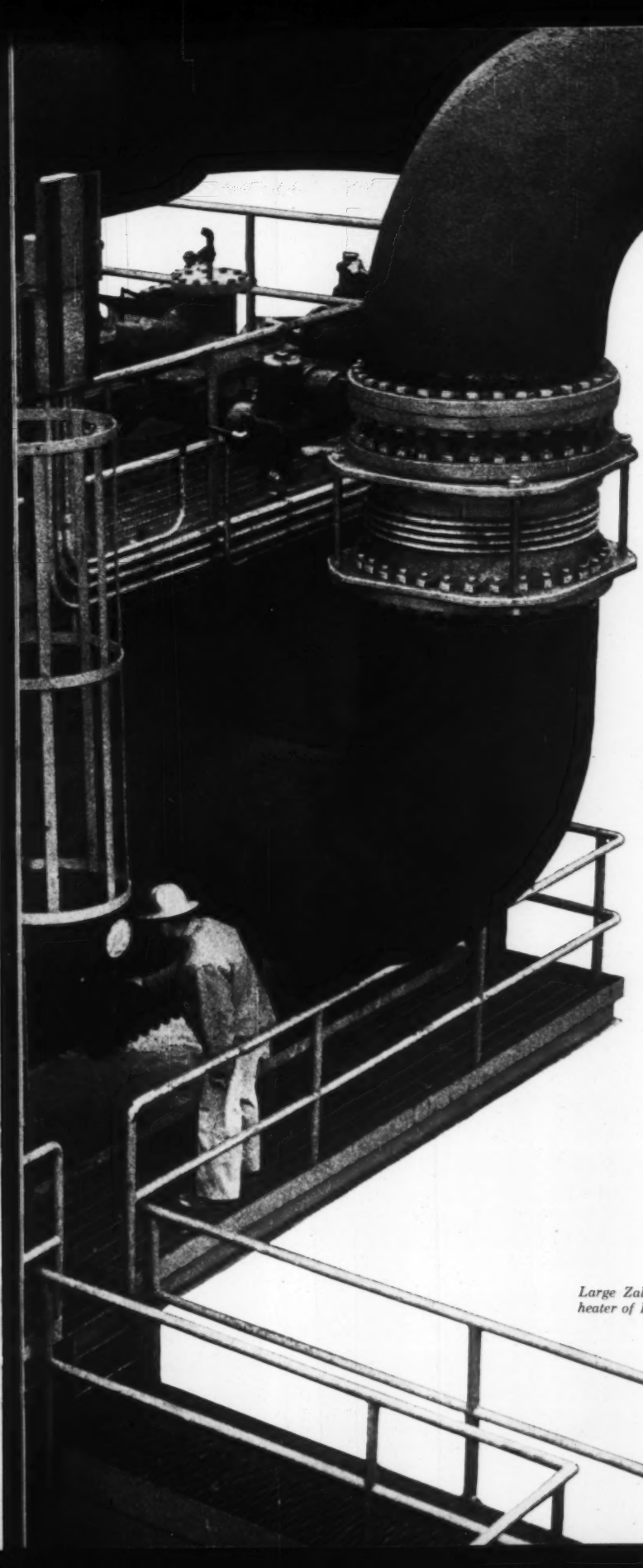


SRE Reactor Control Element Actuators. Sodium Graphite Reactor (SRE) uses eight control actuators. Four function as safety rods, two as shim rods, and two serve as shim regulating rods.



Get positive piping protection with

ZALLEA NON-EQUALIZING EXPANSION JOINTS . . .

Zallea Non-Equalizing Corrugated Expansion Joints offer a degree of protection that can't be equalled for absorbing movement of piping due to temperature changes. They protect interconnected equipment by absorbing movements in otherwise rigid piping systems. They are used in low pressure and vacuum lines . . . between stills, tanks, columns, condensers, pumps and similar equipment.

Standard Sizes: 3″ to 72″ dia.; Special sizes to 50 ft. dia. Pressures: Vacuum to 50 psig. Temperatures: to 1600°F.

Special Applications. With the addition of proper components, Zallea Non-Equalizing Expansion Joints can be used as:

Universal Expansion Joints to absorb movement in any direction . . . axially, laterally, angularly, or any combination of these.

Pressure Balanced Expansion Joints to absorb axial movement outside the unit and still carry pressure thrust.

Hinged and Gimbal Expansion Joints for piping systems that cannot be anchored in the conventional manner.

Get the complete story of Zallea Expansion Joints in our new 72-page manual. They are available for any pressure condition to 3600 psig. Write, on your company letterhead, for your copy of Catalog 56.

Zallea
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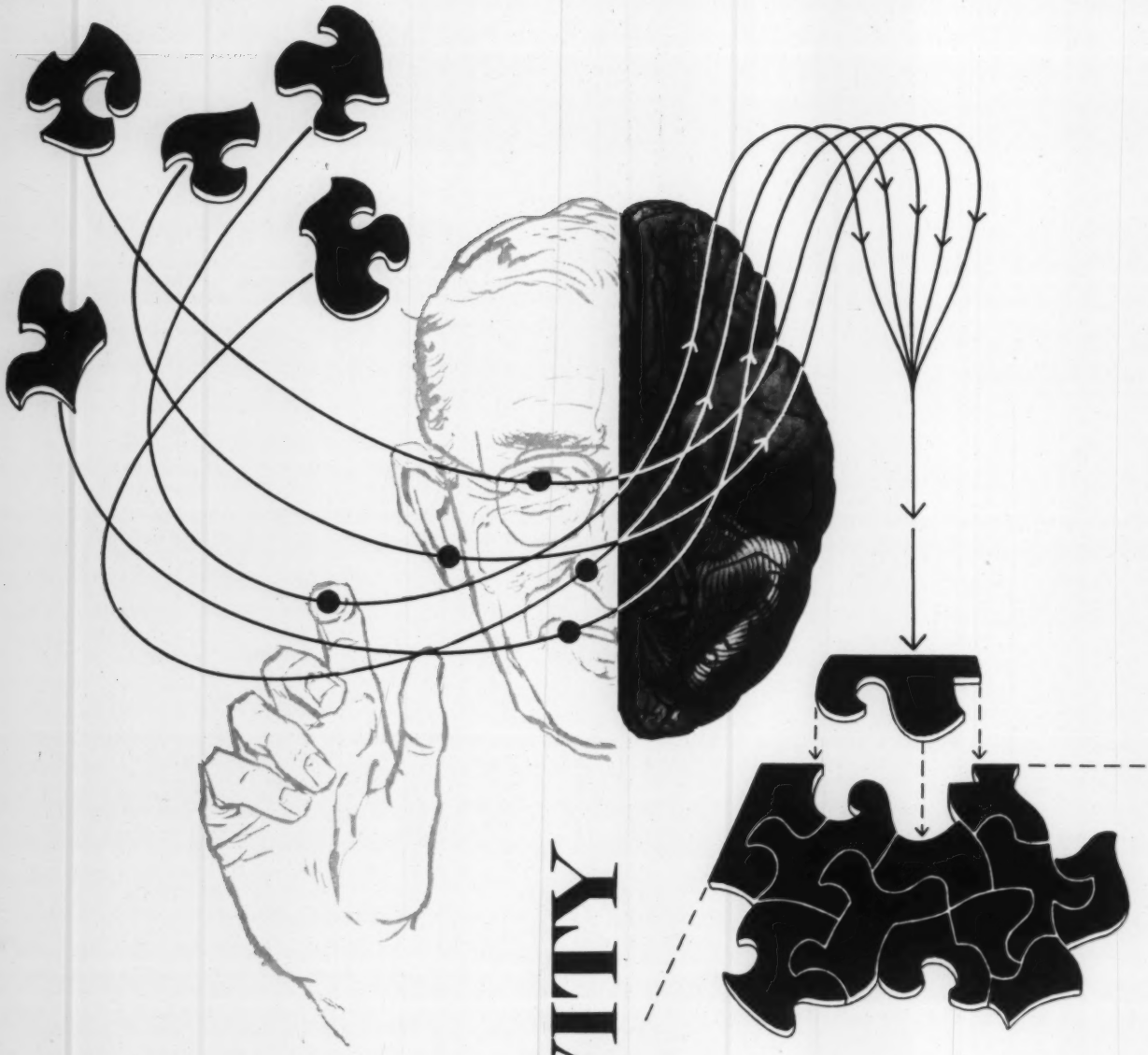
Zallea Brothers • Wilmington 99, Delaware

World's largest manufacturers of expansion joints

Large Zallea Non-Equalizing Expansion Joint installed on deaerating heater of Ford Motor Company's River Rouge plant.



CREATIVITY

Creativity—the continuing progress of civilization and culture is the result of creativity. Science, from the study of the subatomic world to the cosmos, thrives on creativity. The proper environment, availability of equipment, stimulation of other scientists, the challenge to think and the opportunity for interesting problems—these nurture the creative process.

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Twin-shell, triple-lane, single-pass Condenser with 187,000 sq. ft. capacity. One of largest units ever built, it was recently installed at large eastern utility.

In tube layout, too... design makes the difference with C. H. Wheeler condensers

You see here one of the many reasons why C. H. Wheeler Dual Bank Surface Condensers operate so efficiently in scores of public utilities and industrial plants throughout the country.

Triple Lane Tube Layout, with three separate pathways for steam travel, allows the steam to penetrate to the peripheries of all tubes.*

Design like this, typical of C. H. Wheeler engineering, steps up condenser efficiency. Other engineering advancements—such as patented Reverse Flow, which permits flushing away leaves, twigs, algae and other foreign matter—reduce maintenance requirements. "Zero" condensate temperature depression, pure condensate and deaeration to 0.03 cc. of oxygen per liter (special design provides for deaeration to 0.01 cc. of oxygen per liter) . . . are additional features you get with C. H. Wheeler Condensers.

**Location of the air-vapor take-off reduces the resistance to steam passage. This minimizes the depth of steam penetration through the tube bank of all C. H. Wheeler Condensers.*

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Whenever you see the name C. H. Wheeler on a product, you know it's a quality product

Steam Condensers • Steam Jet Vacuum Equipment • Centrifugal, Axial and Mixed Flow Pumps • Marine Auxiliary Machinery • Nuclear Products

STRAIGHT TALK TO ENGINEERS

from Donald W. Douglas, Jr.

President, Douglas Aircraft Company

You may wonder what the future holds for the engineer who decides to build his career in the aircraft/missile industry.

In terms of permanent demand, this industry probably requires a greater proportion of engineers to total personnel than any other. Here at Douglas we are now employing more engineers than we did during World War II.

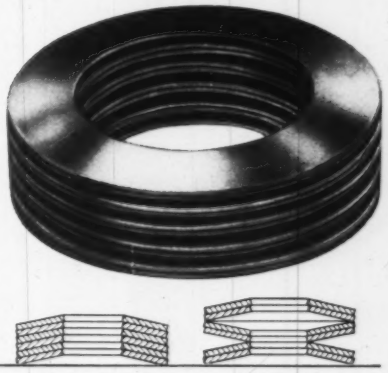
In regard to professional standing, the aircraft/missile industry deals always with the latest state of the art in every engineering and scientific specialty involved. Its engineers are in one of the best informed and highest prestige fields in their profession.

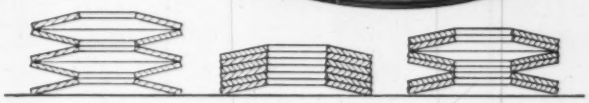
Whatever your present activity, if you decide to move into aircraft, missile and space technology, we would like to talk with you.

Please write to Mr. C. C. LaVene,
Douglas Aircraft Company, Box K-620,
Santa Monica, California

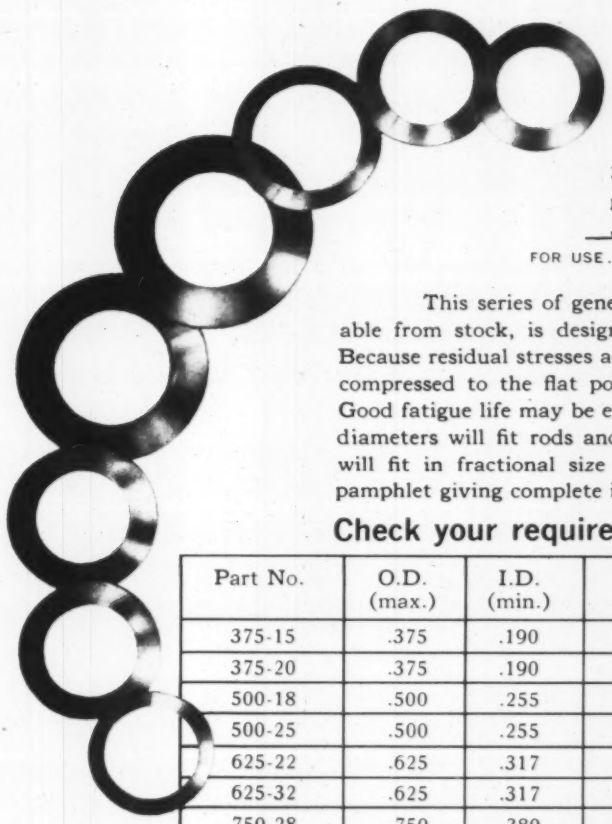
Now . . . IN STOCK for prompt shipment

BELLEVILLE WASHERS





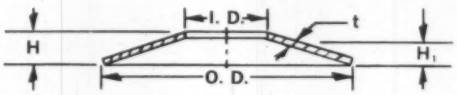
FOR USE . . . IN SERIES . . . . IN PARALLEL . . . . IN PARALLEL-SERIES



This series of general-purpose belleville washers, all of which are available from stock, is designed primarily to carry high loads in limited space. Because residual stresses are introduced during manufacture the washers can be compressed to the flat position and released without loss of free cone height. Good fatigue life may be expected between slight preload and "H_1". The inside diameters will fit rods and bolts of fractional sizes and the outside diameters will fit in fractional size holes. Prices on request. Send for stock washer pamphlet giving complete information.

Check your requirements against these stock sizes

Part No.	O.D. (max.)	I.D. (min.)	t	H (approx.)	H_1	P_1 ±10%	P*
375-15	.375	.190	.015	.027	.021	35	55
375-20	.375	.190	.020	.030	.025	60	110
500-18	.500	.255	.018	.034	.026	45	70
500-25	.500	.255	.025	.038	.031	95	160
625-22	.625	.317	.022	.042	.032	70	105
625-32	.625	.317	.032	.048	.040	145	260
750-28	.750	.380	.028	.051	.039	110	175
750-40	.750	.380	.040	.059	.049	235	415
1000-35	1.000	.505	.035	.067	.051	175	260
1000-50	1.000	.505	.050	.075	.062	340	600
1250-40	1.250	.630	.040	.082	.061	230	330
1250-62	1.250	.630	.062	.092	.077	475	870
1500-45	1.500	.755	.045	.093	.069	284	400
1500-72	1.500	.755	.072	.107	.089	665	1180



*P Calculated Load at Flat Position

5840

Associated Spring Corporation

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Wallace Barnes Division, Bristol, Conn. and Syracuse, N. Y.
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profile of the MECHANICAL CATALOG

MECHANICAL CATALOG

published by
THE AMERICAN SOCIETY OF MECHANICAL ENGI
29 WEST 39TH STREET, NEW YORK 18

June 10, 1958

When your company purchases the following types of products and services, do you have an influence in the purchase? Check below. (Influence = authorize, specify, decide, requisition, recommend, suggest or approve).

PLANT EQUIPMENT	%
Valves	56.9
Pumps	55.7
Pipes and Fittings	52.1
Instrumentation and control	55.9
Turbines	
steam generating	13.3
steam, mechanical drive	14.0
gas, mechanical drive	7.6
Boilers	25.9
Stokers	14.0
Materials Handling Equipment	37.1
Packing, gaskets	37.3
Power Transmission	
gears	36.1
chains	30.8
belts	33.3
couplings	39.4
speed reducers	37.5
Electric Motors	
fractional horsepower	33.9
medium	39.7
large	25.7
Heat exchangers	39.3
Dust & Ash Precipitators	18.8
Fans and Blowers	45.3
Refractories	23.2
Lubricants	34.1
Water Treating Equipment	28.5
Tanks, steel plate	30.5
Engines (internal combustion)	17.9
Expansion Joints	29.6
Machine Tools	27.7
Compressors	32.3
Insulation	37.3
Air Conditioning	30.0
Welding and cutting Equipment	20.9

PRODUCT COMPONENTS	%
Bearings	40.7
Power Transmission	
gears	30.6
chains	23.7
clutches	25.1
Instruments and controls	41.7
Metals	
ferrous	37.2
non-ferrous	36.7
Fasteners and springs	32.7
Electric Motors	
fractional horsepower	27.7
medium	23.6
large	15.0
Gaskets & O-Rings, seals	37.2
Hydraulic pumps and fittings	29.3
Tubing	33.1
Castings and forgings	31.2
Plastic parts	26.2

ENGINEERING TOOLS	%
Drafting Equipment	27.6
Computing and Analyzing Machines	13.6
Electro-mechanical Testing Equipment	25.2

MISCELLANEOUS	%
Nuclear components	7.2
Ultrasonic equipment	7.5
Aircraft parts	5.2
Rocket and Jet Propulsion Machinery	6.2

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Name (Please type or print - last name first)

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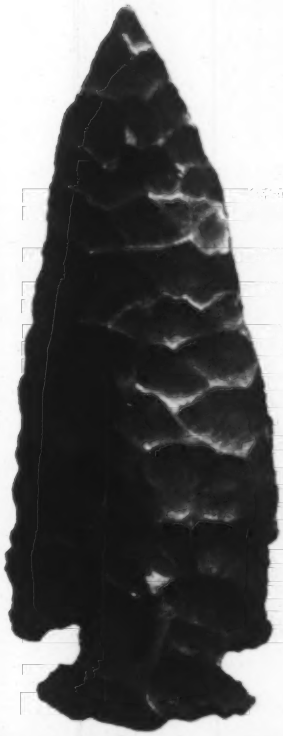
I need MECHANICAL CATALOG for selecting and specifying equipment, materials and supplies. Please send the 1959 edition to me at the address above.

SIGNED 15,458 mechanical engineers*

*total as of August 12, 1958.

Response to 1500 questionnaires selected at random and tabulated by Barnard Inc., independent data compiling bureau of 432 Fourth Avenue, New York 16, N.Y



WARHEAD

circa 400 A. D.

Centuries ago, the Indians of New Mexico designed and developed warheads like this one.

Today, we at Sandia Corporation do very much the same job—but we call it research and development in the ordnance phases of nuclear weapons for the Atomic Energy Commission.

The people who made these primitive warheads also applied many of the same skills and techniques to produce implements of peace—grinding stones, knives, needles, and quite a few others.

Here again, we at Sandia follow a similar pattern. In the pursuit of our main task, we study many things in widely-varied fields ranging from nuclear phenomena to numbers theory, from meteorology to metal-working. We learn basic scientific facts and advanced techniques that have important applications far removed from nuclear weapons.

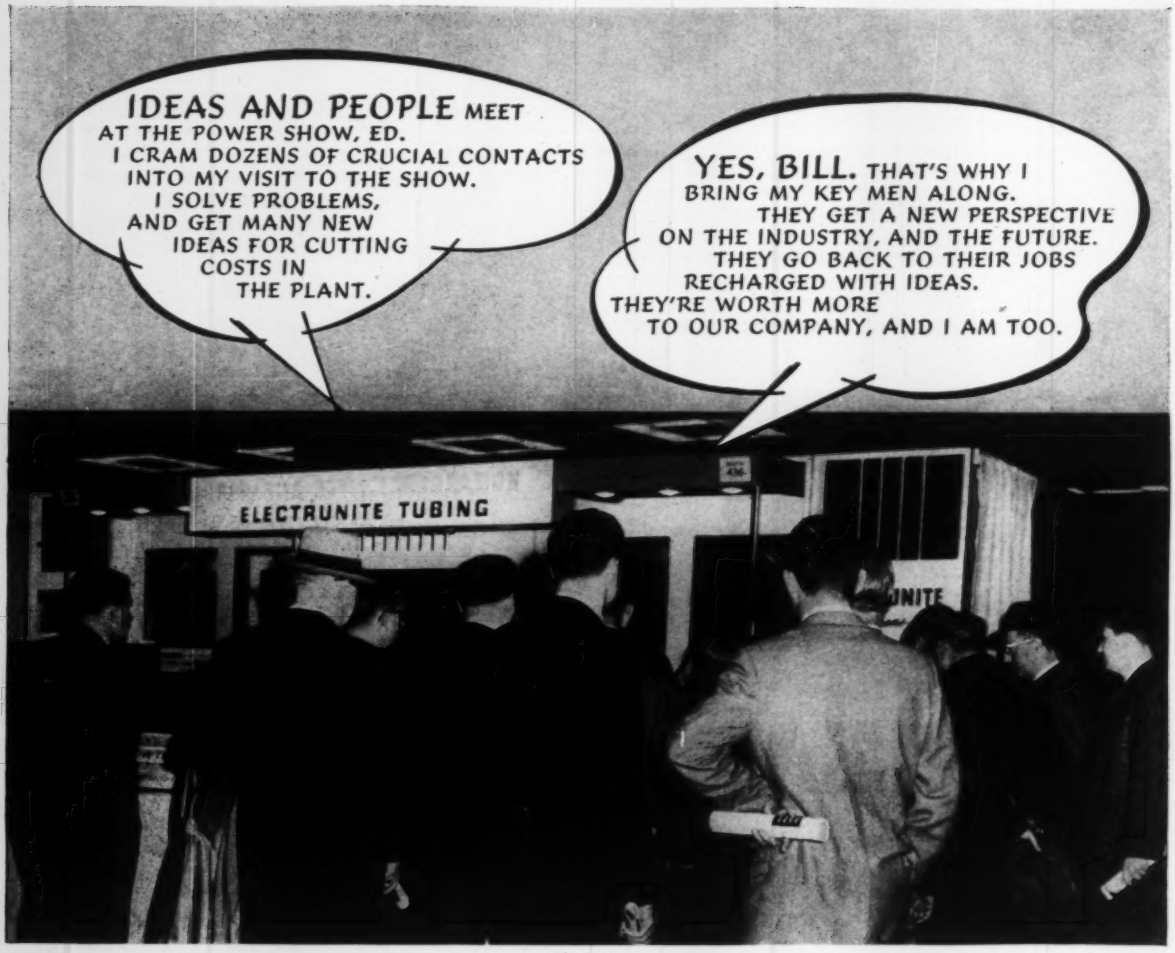
We probe new frontiers of science and engineering. We meet and solve challenging problems in many areas of advanced technology. These are activities which require the services of outstanding engineers and scientists in many fields in our work to maintain our nation's defensive strength.

We have such men—both at Sandia in Albuquerque and at our branch laboratory in Livermore, California. But we need more—at the highest academic and experience levels.

If you are interested in exploring the exceptional opportunities for professional growth and advancement with Sandia Corporation, please write to Staff Employment Section 553C.

SANDIA CORPORATION

ALBUQUERQUE, NEW MEXICO


IDEAS AND PEOPLE MEET AT THE POWER SHOW, ED. I CRAM DOZENS OF CRUCIAL CONTACTS INTO MY VISIT TO THE SHOW. I SOLVE PROBLEMS, AND GET MANY NEW IDEAS FOR CUTTING COSTS IN THE PLANT.
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Lectrodryer offers reliable assistance in solving any type of DRYing problem. Mail coupon below for help in getting rid of unwanted moisture in air, gases or organic liquids.

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AIR CONDITIONING and VENTILATION: Cicero Sheet Metal Co.

Efficient Manufacture Employee Well-being

both aided by Clarage "air" in new Avon cosmetics plant

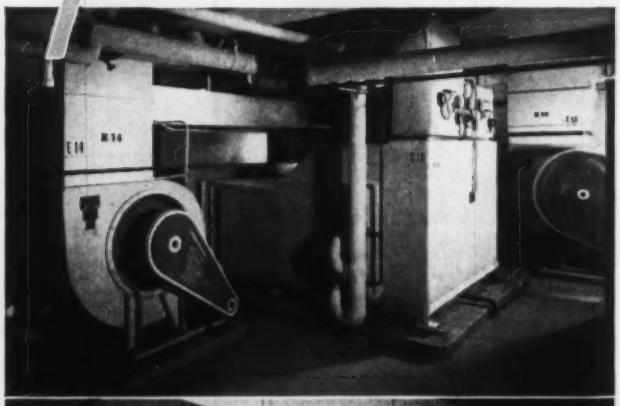
Here is much more than a thoroughly modern manufacturing facility. Here is a national sales center as well.

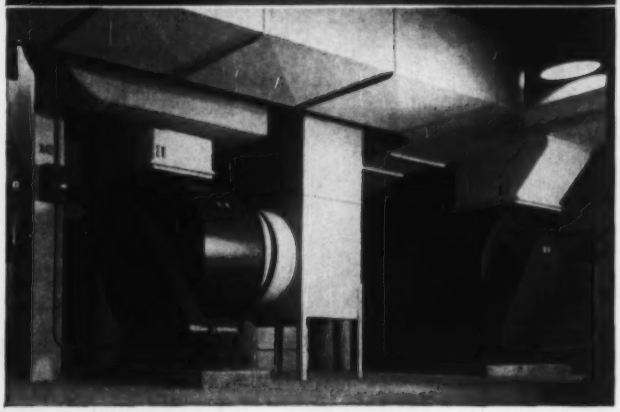
It's the new Avon Products, Inc., plant at Morton Grove, Illinois. From it flow the widely popular Avon cosmetic products. To it come members of Avon's door-to-door sales organization for training and sales meetings.

Air conditioning, thus, has a dual role to play in this structure — for employee comfort and for efficient manufacturing processes.

As for so many other noteworthy buildings, Clarage equipment was selected — some of which is shown on the right. On the job are Clarage Ready Unit ventilating sets, system fans, and Multitherm air conditioning units, including the famous Blow-Thru units pioneered and perfected by Clarage for multi-zone service.

You, too, will find it profitable to specify Clarage for your next assignments — no matter how large, how small. CLARAGE FAN COMPANY, Kalamazoo, Michigan.





CLARAGE ... *dependable equipment for making air your servant*

SALES ENGINEERING OFFICES IN ALL PRINCIPAL CITIES • IN CANADA: Canada Fans, Ltd., 4285 Richelieu St., Montreal

Penetrates through rust
like coffee soaks into a sugar cube!

How much do you spend on removing rust before you paint? Why not coat right over the sound rusted metal with Rust-Oleum 769 Damp-Proof Red Primer after simple scraping and wire-brushing to remove rust scale and loose rust . . . saving time, money, and metal! Rust-Oleum's specially-processed fish oil vehicle penetrates* through rust to bare metal—while the surface film remains *tough*, *firm*, and *durable*. You cut costly surface preparations, you receive nearly 30% greater coverage depending upon the condition and porosity of the surface—and you receive the *maximum* in over-the-years protection!

Whatever your color choice may be—Rust-Oleum finish coatings include the color you want. They're manufactured under the same *exclusive* formulation as the Rust-Oleum Primer . . . they assure you of *greater* compatibility, *double* protection, and *lasting* beauty! The best way to see what Rust-Oleum will do for you is to actually try it yourself . . . around your plant or home.

See our complete catalog in Sweets, or send the coupon for a free Rust-Oleum Test Sample . . . one brushful means *more* than a thousand words. Prompt delivery from Industrial Distributor stocks.

*As proved by Battelle Memorial Institute Technologists in radioactive tracing studies.

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Distinctive as your own fingerprint. Accept no substitute.

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- ☐ 30-page report on Rust-Oleum penetration
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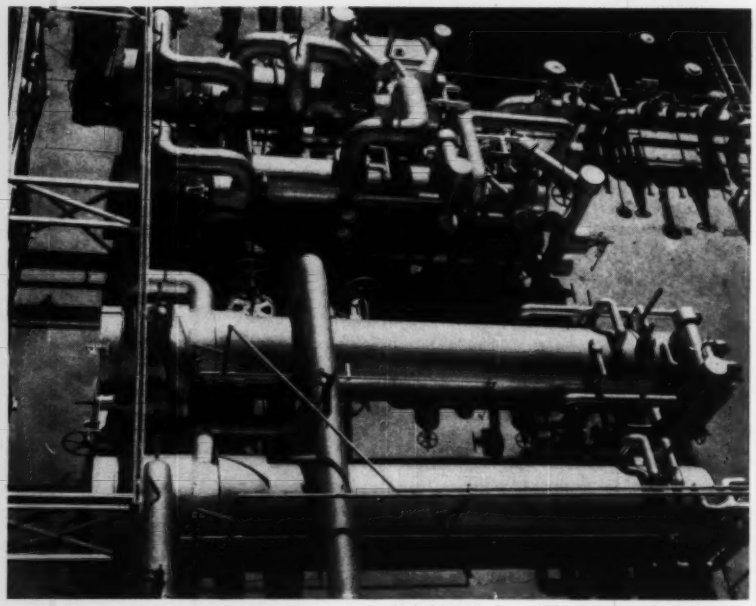


Consulting Engineers, Ebasco Services Incorporated

The modern, efficient equipment shown here was designed and built by the Yuba Heat Transfer Division for the Collin Station of the Texas Power & Light Co. Serving a 110,000 KW turbine are five Yuba feedwater heaters, of which four are shown here. Two high-pressure heaters are designed for 2600 psi on the tube side with 6500 and 6750 sq. ft. of surface. Three low-pressure heaters are designed for 400 psi on the tube side and have 2850, 3165 and 4670 sq. ft. of surface.

FEEDWATER HEATERS . . . Yuba designed and built the *first* all-welded feedwater heaters, in service for the last year and a half. The weld technique was used in the tube bundles, shells and Multilok Closures. These all-weld heaters have started an industry trend.

CONDENSERS . . . Yuba is building condensers having 200,000 sq. ft. of total surface. The designs are readily adapted to condensers of even greater capacity as required for larger turbines.

EVAPORATORS . . . Yuba evaporators have achieved boiler make-up water purity of less than .2 ppm. Yuba can *guarantee* purity of .25 ppm solids content per 3000 ppm shell concentration.

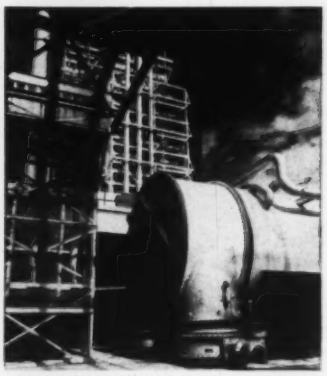
Engineering accomplishments such as these keep the power industry up-to-date. There's progress in power through progress in heat transfer equipment.

For information on Yuba power equipment contact
YUBA HEAT TRANSFER DIVISION
Honesdale, Pa.

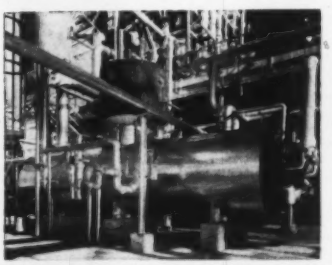
YUBA

EQUIPMENT will still be UP-TO-DATE TOMORROW

...because it's ahead today



Twin-unit surface condenser has 90,000 sq. ft. of surface. Operates at 26.52 inches of vacuum with oxygen content in the condensate less than 0.01 cc per liter.



Bubble-tray evaporator produces 34,000 lb./hr. of vapor well below 1.0 ppm total solids with 3000 ppm concentration.

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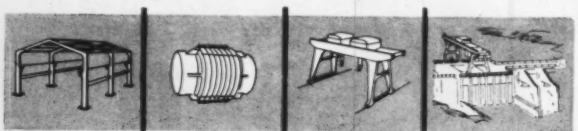
OTHER YUBA PRODUCTS FOR THE POWER INDUSTRY



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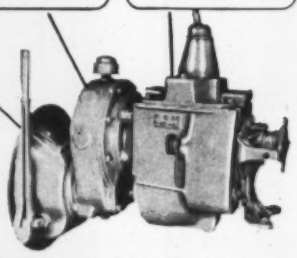

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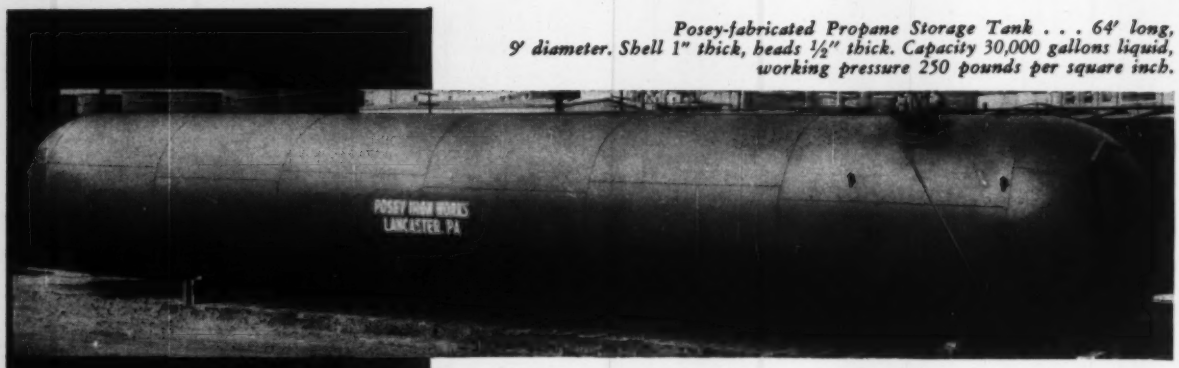

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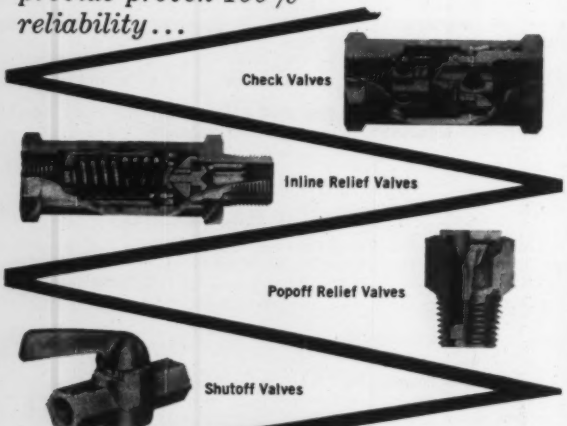

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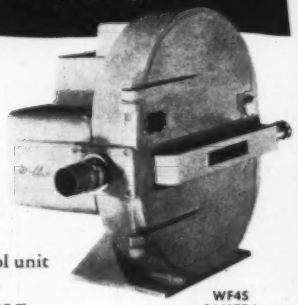

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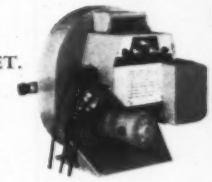

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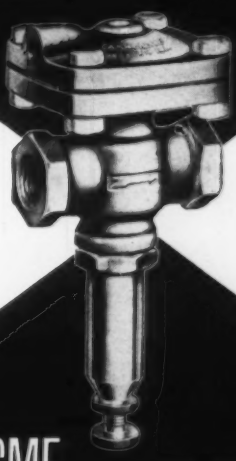

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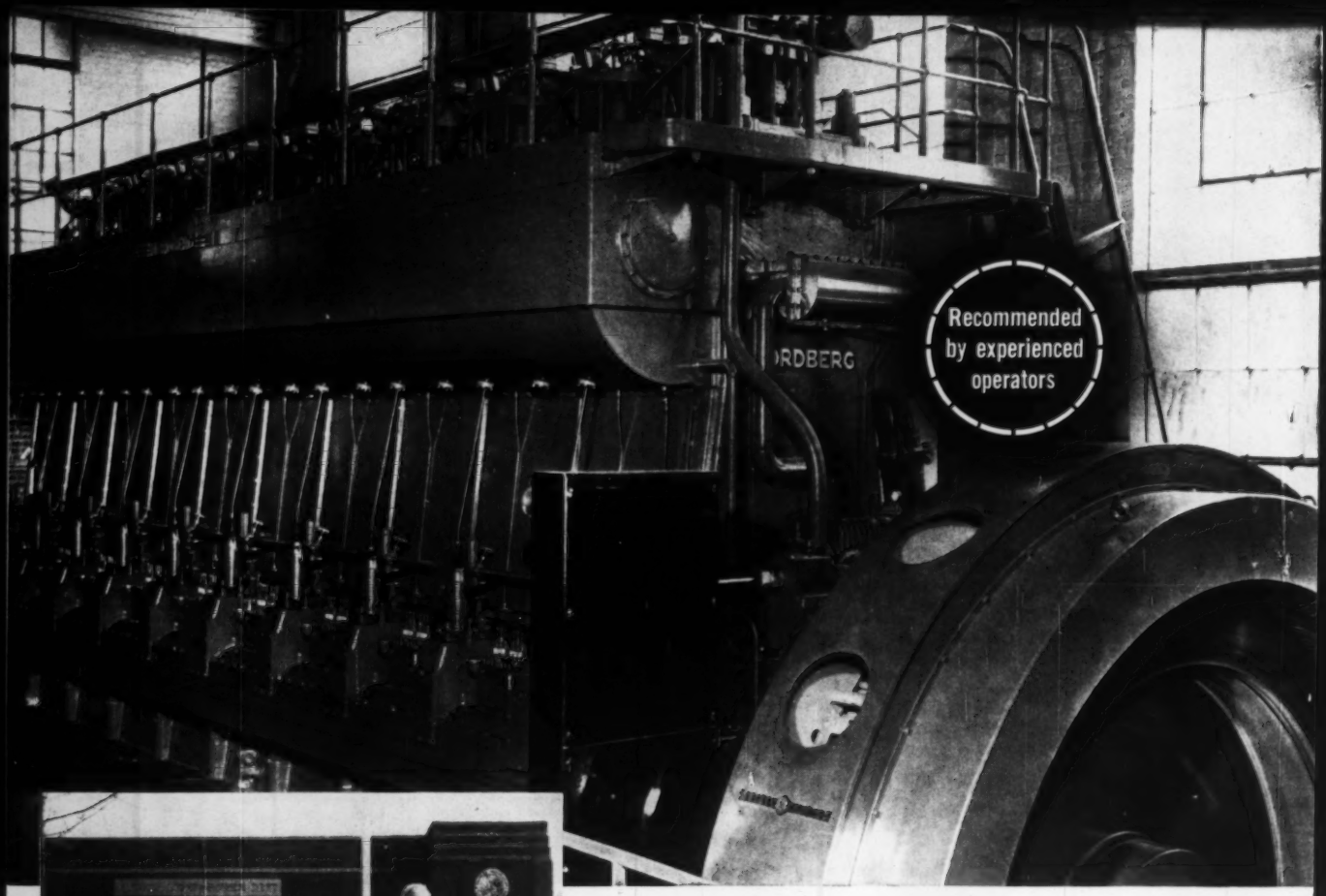

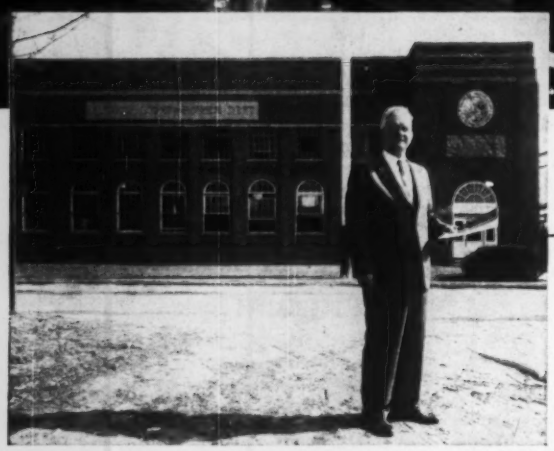

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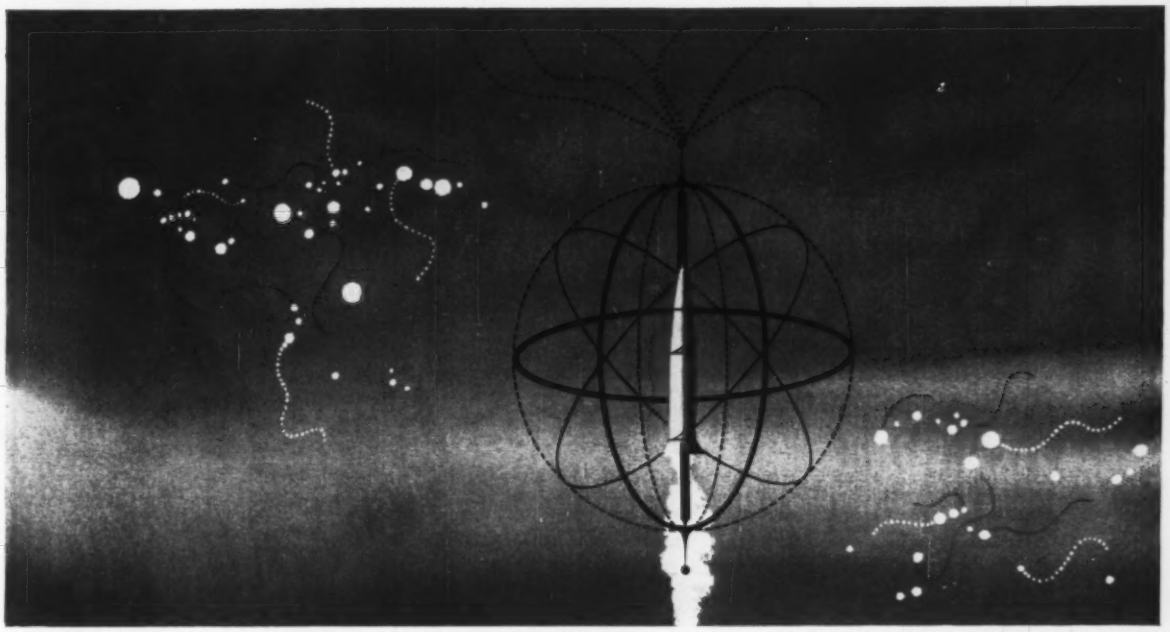

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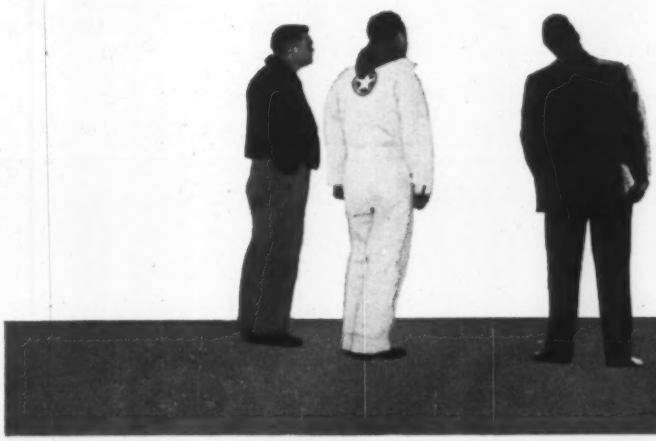

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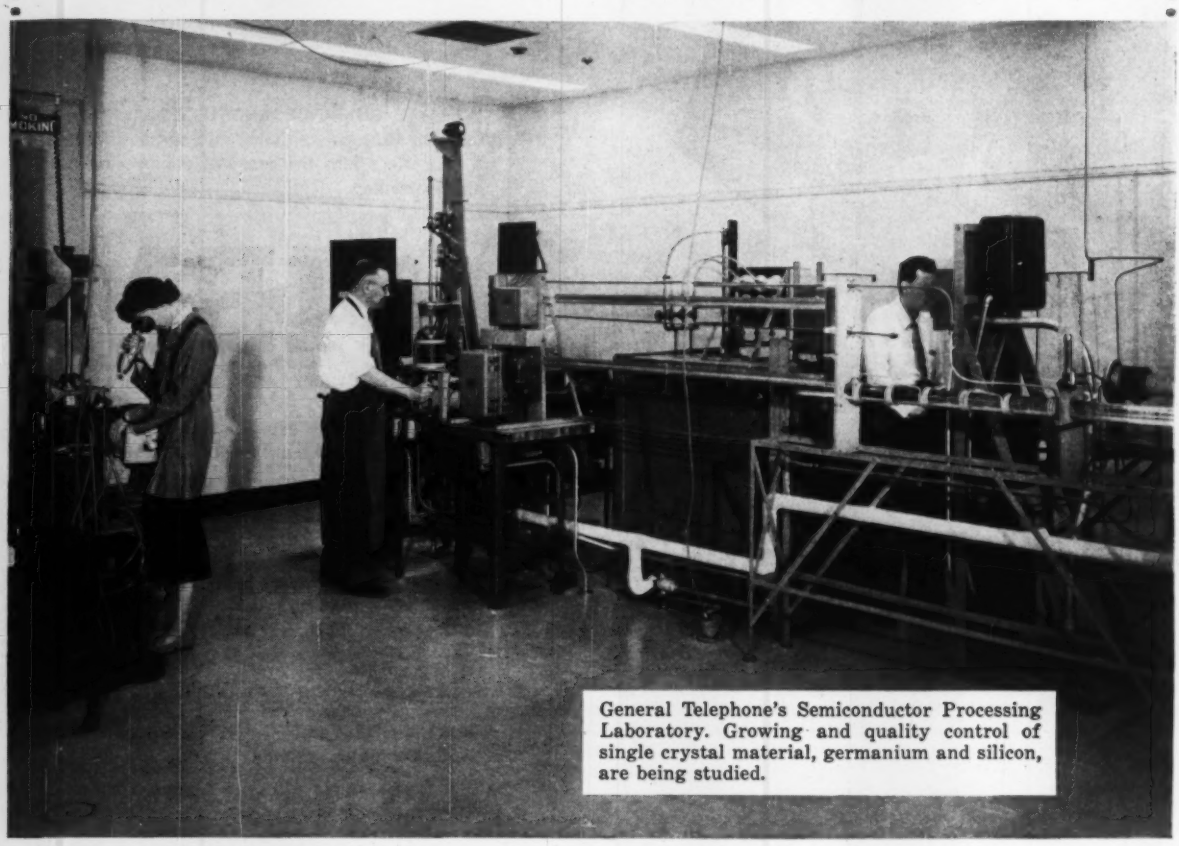

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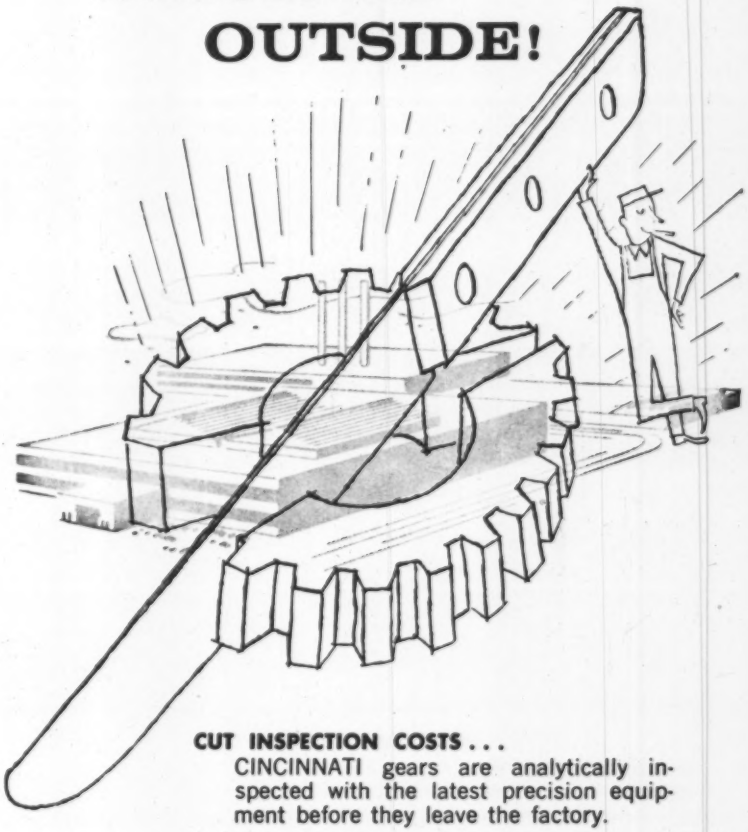

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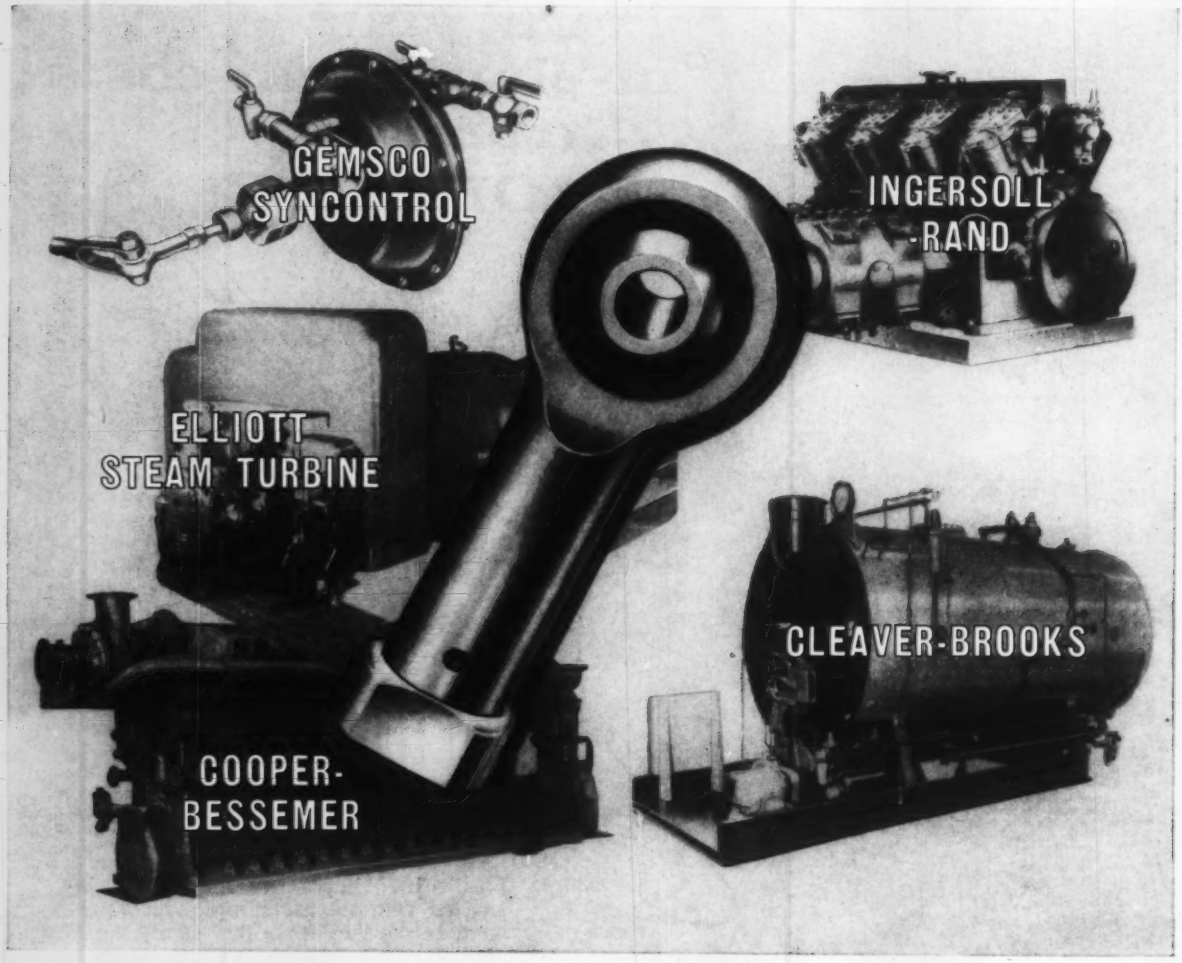

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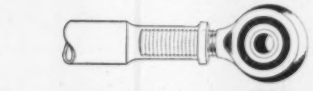
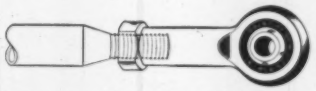


Female threaded rod with adjustable male unibal rod end bearing



Male threaded rod with adjustable female unibal rod end bearing

Because of the universal motion of the single ball, the Heim Unibal Bearing has the ability to correct shaft or linkage misalignment in all directions.

Assembly is quick and simple. Greater load ratings for substantially smaller dimensions are attained.

Many leading manufacturers of equipment requiring push-pull linkages depend on Heim Unibal.

Call or write now for engineering advice and complete catalog. Also list of distributors and representatives.

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For Prompt Service, contact any one of our more than 150 distributing points across the country.

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LQ600®

Here's Why: Long accepted valve maintenance costs are a thing of the past in thousands of plants where LQ600's have been installed . . . even in the most severe services where previous valves required repair or replacement after as little as two weeks on the line.

These outstanding savings are made possible by seats and discs of Brinalloy®, a patented Lunkenheimer alloy that is more resistant to wear and corrosion than 500 Brinell Stainless or 1000 Brinell Case-Hardened Stainless Steel.

Add to this the Lunkenheimer exclusive silicon-bronze Stemalloy®, the most durable stem material ever put into a valve, and you have two important reasons why LQ600's have established new low-maintenance standards everywhere they are installed.

For an actual comparison test, call the Lunkenheimer Distributor in your area. He is an expert on valve maintenance costs and will be glad to demonstrate the maintenance-saving benefits you receive when you install LQ600's . . . or write The Lunkenheimer Company, Cincinnati 14, Ohio

LQ600-150 150 lb. S.P., 300 lb. W.O.G.

LQ600-200 200 lb. S.P., 400 lb., W.O.G., 550°F.

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A smart bearing buyer knows this sign means value...

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